VIRTUAL NUCLEAR POWERS, NUCLEAR-POWERED SUBMARINES AND ILLICIT NUCLEAR TRADE: HOW THE SPREAD OF TECHNOLOGICAL KNOW-HOW AND MANUFACTURING CAPABILITIES IS UNDERMINING THE NONPROLIFERATION REGIME

by
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A thesis submitted to Johns Hopkins University in conformity with the requirements for the degree of Master of Arts in Global Security Studies

Baltimore, Maryland
May 2015

Abstract

This study investigates how the spread of technological know-how and nuclear technology resulted in the emergence of new threats to the Nuclear Non-Proliferation Treaty (NPT). Currently, the world has to deal with the perils of latent proliferation, in which a country adheres to the NPT while nevertheless developing the capabilities needed for a nuclear weapons program.

The first chapter argues that nuclear cooperation under the auspices of the NPT resulted in the emergence of virtual nuclear powers (VNPs) - countries that are able to develop nuclear weapons but stop before assembling them. This study concludes that in reaction to the emergence of VNPs, nuclear weapon states (NWS) are not only imposing harsh conditions on the transfer of civilian nuclear technology to nonnuclear weapon states (NNWS), but also prioritizing the non-proliferation pillar of the agreement, undermining the grand bargain that sustains the treaty.

The second chapter investigates whether the Brazilian nuclear-powered submarine poses a growing risk to the nonproliferation regime. The lack of regulation concerning naval propulsion reactors (NPRs) might work as a good excuse for a country that is willing to produce weapons grade uranium and resume its nuclear weapons program. After all, Highly Enriched Uranium (HEU) designated for NPRs are exempt from the IAEA safeguards. The case study based on open sources concludes, however, that domestic and international legal constraints impede the development of a nuclear weapons program in Brazil.

The last chapter of the paper looks into the effectiveness of United Nations sanctions on nuclear proliferant states involved in illicit nuclear trade. Investigating North Korea and Iran, this study tests the hypothesis that sanctions might slow down the development of nuclear programs but do not prevent the engagement of states in illicit nuclear trade because the spread of technological know-how and manufacturing capabilities in the past decades had a major impact on the nuclear weapons and missile programs of several developing countries. The research concludes that they are able to support one another directly at the state-to-state level or indirectly through private sector supply networks. Illicit trade is also facilitated by lax export controls and uneven implementation of sanctions.

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Contents

Thesis introduction

The three chapters of my thesis look into how the spread of nuclear technology jeopardizes the nonproliferation regime. The general argument is that peaceful nuclear cooperation resulted in latent proliferation and the creation of a new category of countries that control the full nuclear cycle and engage in activities that defy the nonproliferation regime, such as nuclear-powered submarine programs and illicit nuclear trade.

It is undeniable that peaceful nuclear cooperation allowed the improvement of the lives of millions that now have access to electricity generated by power plants and the advantages of naval nuclear propulsion systems. The downside is that more countries are now able to accumulate highly enriched uranium (HEU) and plutonium as a byproduct of the generation of nuclear electricity. In addition, currently there are more rogue actors engaged in illicit nuclear trade, providing nuclear material and technology in the black market, which is also undermining the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) and the sanctions regime.

In general, the methodology involved the research of three different topics: the emergence of the so-called virtual nuclear powers (VNPs), countries that only depend on a political decision in order to go nuclear and are a direct consequence of peaceful nuclear cooperation under the NPT[1]; the development of nuclear-powered submarine programs, which might result in the increase of HEU and plutonium in the world; the development of proliferation of networks in developing countries that are engaged in illicit nuclear trade and are able to bypass export controls, sanctions and the whole nonproliferation regime.

[1] "Virtual Nuclear Powers a Looming Threat, ElBaradei Warns," The Guardian, May 2009.

In the first chapter, I argue that nuclear cooperation under the NPT resulted in the emergence of VNPs - countries that are able to develop nuclear weapons but stop before assembling them. According to former IAEA Director General Mohamed ElBaradei " (...) this phenomenon goes much beyond Iran. Pretty soon ... you will have nine weapons states and probably another 10 or 20 virtual weapons states[2]." Then, I proceed to investigate whether the emergence of VNPs is closely related to the spread of nuclear technology and pose a threat to the NPT.

In this sense, I rely on a research conducted by Matthew Fuhrman, who establishes a direct relationship between what he calls peaceful nuclear cooperation and nuclear weapons proliferation. He analyzed 2,000 Nuclear Cooperation Agreements signed from 1945 to 2000 and concluded that nuclear aid increases the likelihood of acquiring the bomb by about 360 percent; the combination of atomic assistance and militarized conflicts increases the probability of building nuclear weapons by 750 percent[3]. However, this relationship is probabilistic not deterministic, simply because not all recipients of assistance will cross the nuclear threshold[4].

The research methodology attempts to demonstrate how nuclear cooperation resulted in the development of nuclear programs in Iraq, North Korea, Iran, and even Syria. I also analyzed the North Korean program in a case study. After all, the North Korean case demonstrates how the signing of a peaceful cooperation agreement with the Soviets in 1959 ended up in the acquisition of the bomb a few decades later. It is also

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[2] Virtual Nuclear Powers a Looming Threat, ElBaradei Warns, The Guardian, May 2009.

[3] Matthew Furhmann, "Spreading Temptation: Proliferation and the Peaceful Nuclear Cooperation Agreements," International Security, 2009, pp. 39-41.

[4] Sonali Singh and Christopher R Way. "The Correlates of Nuclear Proliferation: A Quantitative Test," *Journal of Conflict Resolution*, 2004.

important to highlight the fact that the country was the first nonnuclear weapon state to withdraw from the NPT. I conclude that nuclear assistance really gives rise to VNPs, undermining one of the most important pillars of the nonproliferation regime. After all, "none of today`s nine nuclear weapons states achieved their status without the assistance from people, information, equipment and/or sensitive technology that came from somewhere else[5]."

In the second chapter, I look into the Brazilian nuclear-powered submarine program and how the lack of regulation concerning naval propulsion reactors (NPRs) might work as a good excuse for a country that is willing to produce weapons grade uranium and resume its nuclear weapons program. After all, the NPT does not regulate the production, use and disposal of Highly Enriched Uranium for naval nuclear reactors, which means that submarines are not subject to the safeguards regime. Moreover, the same technology that makes fuel for nuclear reactors can also produce explosive material for nuclear bombs – the dual-use technology dilemma.

The Brazilian precedent would make it easier for other states that may have nuclear weapons ambitions to use the NPT exclusion for submarine reactor fuel as cover for the pursuit of nuclear weapons[6]. Since it is an ongoing project, the research methodology was based on the history of the Brazilian nuclear program, official speeches, documents and declarations, which were analyzed to assess the real intentions of the Brazilian government. In order to confirm my hypothesis, I had to look for any

[5] Jack Boureston and James A. Russell, " Illicit Nuclear Procurement Networks and Nuclear Proliferation: Challenges Intelligence, Detection, and Interdiction," Stair, 2009, p. 41.

[6] Greg Thielmann, and Serena Kelleler-Vergatini, "The Naval Nuclear Reactor Threat to the NPT," The Arms Control Association, July 24, 2013.

indication in previous researches that Brazilian enrichment facilities tried to produce or accumulate HEU.

I conclude that there are no reasons to believe that Brazil is willing to resume its nuclear weapons program, even though there is no credible way to assess whether the country is accumulating HEU at the moment. However, the Brazilian nuclear-powered submarine program has potential to pose a threat to the NPT because the spread of nuclear fuel enrichment techniques will result in more VNPs. In addition, it will become harder for the IAEA inspectors to oversee uranium production and implement the safeguards when needed. Since Brazil will open the precedent it is likely that other countries will follow suit, which might also lead to the increase of enriched uranium and plutonium in the world.

In the last chapter I ask whether sanctions prevent the engagement of nuclear proliferant states in illicit nuclear trade. Basically, there are two reasons that explain the emergence of nuclear proliferation networks: the will to build nuclear weapons and the impossibility of legally obtaining the required goods. The spread of technological know-how and manufacturing capabilities in the past decades had a major impact on the nuclear weapons and missile programs of several developing countries, which are able to support one another directly at the state-to-state level or indirectly through private sector supplier networks. In addition, developing countries have poor history of implementing trade controls and UN sanctions[7].

The development of these networks of second-tier proliferators will undermine the sanctions regime, as developing countries create indigenous nuclear weapons and

[7] David Albright, Andrea Stricker, and Houston Wood, "Future World of Illicit Nuclear Trade: Mitigating the Threat," Institute for Science and International Security, July 29, 2013.

delivery system technologies, increasingly disconnecting from first-tier state and trading among themselves for the capabilities that their programs lack. In this paper, first-tier refers to advanced industrialized states and second-tier refers to developing industrial states with the exception of Russia and China, which are NWS under the NPT[8]. Thus, both countries had access to sensitive technology in the early stages of the nuclear era, just like the other NWS: U.S, the United Kingdom and France. In this sense, they are considered to be first-tier states.

With regard to methodology, I analyzed two case studies of countries that are systematically resorting to illicit nuclear trade, in spite of all the sanctions against them. The nuclear programs of North Korea and Iran pose a real threat to the nonproliferation regime because they reinforce the risk of latent proliferation, in which countries adhere to the NPT but also try to develop nuclear weapons capability. In the long run Iran can either continue as nonnuclear weapons state under the NPT or even follow North Korea`s path and withdraw from the treaty.

In order to assesss the effectiveness of the implementation of sanctions on North Korea, I relied on the UN North Korea Sanctions Panel report released on June 2013. According to the report, North Korea continues to bypass UN sanctions in order to supply its WMD programs, import and export conventional arms, and import luxury goods. At the same time, I relied on the UN Iran Sanctions Panel report released on June 2014 to assess the implementation of sanctions on Iran. The report shows that Iran has been breaching sanctions by procuring both controled and non-controled goods.

[8] Chaim Braun and Christopher F. Chyba, " Proliferation Rings: New Challenges to the Nuclear Nonproliferation Regime," International Security, Vol 29, No. 2 (Fall 2004), pp. 5-49.

I conclude that both countries are still deeply involved in illicit nuclear trade. It is interesting to notice that many illicit goods en route to Iran and North Korea are shipped from China. However, it is not clear whether the Chinese government is involved or everything is just a matter of lax export controls. It is also interesting to notice that second-tier developing countries have a poor record of implementing trade controls and sanctions and an increasing ability to manufacture reliable dual-use components. Hence, sanctions were never adopted universally or applied effectively due to the inexistence of efficient export control regimes in second-tier states.

Chaim Braun and Christopher F. Chyba argue that an effective response to the current proliferation challenges must address both the supply and the demand sides of the problem. On the one hand, adressing the supply side requires limiting the transfer of weapons-grade material or nuclear weapons technology from first-tier suppliers to potential proliferators[9]. On the other hand, demand side policies must take into consideration the factors that states take into consideration when deciding their nuclear-weapons and missile delivery sistems.

After all, the nature of nuclear proliferation has been changing since the Treaty on the NPT entered into force in 1970. Throughout these four decades, nuclear technology has become more accessible and cheaper due to article IV of the NPT, which acknowledged the right to pursue a peaceful nuclear program, and also due to the development of several uranium enrichment techniques.

The international community believed for a long time that nuclear cooperation for peaceful purposes would inhibit the proliferation of atomic weapons. During his Atoms

[9] Chaim Braun and Christopher F. Chyba, " Proliferation Rings: New Challenges to the Nuclear Nonproliferation Regime," International Security, Vol 29, No. 2 (Fall 2004), pp. 5-49.

for Peace speech, President Dwight D. Eisenhower affirmed that one of the most important responsibilities of the Atomic Energy Agency would be to devise methods whereby fissionable material would be allocated to serve the peaceful pursuits of mankind. Therefore, experts would be able to apply nuclear energy to the needs of agriculture, medicine and electrical energy, especially in the power-starved areas of the world[10].

David Fischer explains that the International Atomic Energy Agency was created in 1957 in response to "the deep fears and expectations resulting from the discovery of nuclear energy[11]." Its genesis can be traced back to President Eisenhower`s Atoms for Peace address to the General Assembly of the United Nations. The NPT was proposed by Frank Aiken, Irish Minister for External Affairs. However, it was only opened for signature in 1968. It is interesting to notice that accession became nearly universal after the end of the Cold War. In 1992, China and France finally signed the treaty, the last of the five of the five nuclear weapon states (NWS) recognized by the NPT and in 1995 the it was extended indefinitely.

The NPT rests on three pillars: nonproliferation, the peaceful use of nuclear energy, and disarmament. In this sense, the nonproliferation regime is based on the underlying assumptions that nonnuclear weapon states (NNWS) would give up nuclear weapons if they could have access to the benefits of peaceful nuclear cooperation. In addition, nuclear weapon states (NWS) should proceed to disarm themselves and pledge

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[10] Dwight D. Eisenhower, "Atoms for Peace," Voices of Democracy, December 8, 1953. http://voicesofdemocracy.umd.edu/eisenhower-atoms-for-peace-speech-text/

[11] David Fischer, " History of the International Atomic Energy Agency: The First Forty Years," Vienna: The Agency, 1997. http://www-pub.iaea.org/MTCD/publications/PDF/Pub1032_web.pdf

not to transfer nuclear weapons to any recipient or in any way assist, encourage or induce any non-nuclear weapon state in the manufacture or acquisition of nuclear weapons.

Article IX of the NPT defines a nuclear-weapon state as a state that manufactured and exploded a nuclear weapon or other nuclear device prior to 1 January, 1967[12]. These states are: China, France, Russia, the United Kingdom and the United States. All other states are non-nuclear weapon states under the Treaty. Under article II of the NPT, non-nuclear-weapon states pledge not to acquire or exercise control over nuclear weapons or other nuclear explosive devices and not to seek or receive assistance in the manufacture of such devices. Under article III of the treaty, non-nuclear weapon states pledge to accept IAEA safeguards to verify that their nuclear activities serve only peaceful purposes. Finally, article IV acknowledges the right of all parties to develop nuclear energy for peaceful purposes: "nothing in this treaty shall be interpreted as affecting the inalienable right of all the parties to the Treaty to develop research, production and use of nuclear energy for peaceful purposes without discrimination and in conformity with articles I and II of this treaty."

In this regard, it is important to bear in mind that article IV of the NPT is one of the three pillars of the NPT that is under attack. It acknowledges the right of all parties to develop nuclear energy for peaceful purposes but the treaty - aware of the perils of the proliferation of nuclear technology – also establishes that NNWS should accept that safeguards be applied to all nuclear material used for civilian purposes. Currently, however, it is possible to say that nuclear cooperation and proliferation are intertwined due to the spread of nuclear technology and its dual-use nature: the same technology that

[12] Jacques E.C. Hymans, " When Does a State Become a Nuclear Weapon State? An Exercise in Measurement Validation," Nonproliferation Review, Vol.17, No 1, March 2010.

is used for peaceful purposes can be reversed and used for the destruction of mankind. In 1979, Albert Wohlstetter was already trying to warn the international community:

> If, in fact, technological transfers can bring a "nonnuclear weapon state" within weeks, days or even hours of the ability to use a nuclear explosive, in the operational sense that "nonnuclear weapon state" will have nuclear weapons. The point is even more fundamental than the fact that effective safeguards mean timely warning. A necessary condition for timely warning is that there be a substantial elapsed time, But if there is no substantial elapsed time before a government may use nuclear weapons, in effect it has them[13].

I have always asked myself whether a regime that establishes five NWS and hundreds of NNWS is sustainable in the long term. Any functional regime, according to Mohamed ElBaradei, must have a sense of fairness and equity that is not present in the NPT[14]. After all, realists argue that institutions or regimes are a mere reflection of the distribution of power in the world, despite the fact that a liberals argue that institutions are an important cause of peace because they can alter state preferences and change state behavior. In this regard, Stephen Krasner defines regimes as "institutions possessing norms, decision rules, and procedures which facilitate a convergence of expectations[15]." Therefore, they establish acceptable and unacceptable kinds of behavior.

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[13] Albert Wohlstetter, Gregory Jones, and Roberta Wohlstertter, "Why the Rules Needed Changing," Part I of Towards a New Consensus on Nuclear Technology, vol.1 (Los Angeles: Pan Heuristics, 1979), p. 36.

[14] "Virtual Nuclear Powers: a Looming Threat, ElBaradei Warns," The Guardian, May 2009.

[15] Stephen D. Krasner, "Structural Causes and Regime Consequences: Regimes as Intervening Variable." International Regimes, Ithaca, NY: Cornell University Press, 1983.

The nonproliferation regime mirrors the distribution of world power right after the Second World War. After all, " the most powerful states create and shape institutions so that they can maintain their share of world power[16]." The very same permanent members of the UN Security Council –U.S, United Kingdom, China, Russia and France - are the NWS that are legally allowed to have nuclear weapons. The other member states – NNWS - are supposed to believe that the P5 are responsible enough to hold the most powerful weapons ever invented while they are only supposed to have access to the peaceful use of nuclear energy. Despite the obvious inequality, it is possible to say that the regime is working from the perspective of the number of adherents: a total of 191 states have joined the Treaty, though North Korea, which acceded to the NPT in 1985 but never came into compliance, announced its withdrawal in 2003.

The treaty acknowledges the fact that international relations is in a state of relentless security competitiveness with the possibility of conflict always in the background. In this sense, cooperation against proliferation continued way beyond the cold war because of mutual interests in preserving the nuclear status quo that transcended bipolarity and not as the result of fundamental changes in international behavior. According to realists, the continuing threat of unchecked nuclear proliferation makes possible an unusual degree of international cooperation[17]. At the same time, however, article X establishes the right to withdraw from the Treaty giving three months` notice

[16] John J. Mearsheimer, " The false Promise of International Institutions," International Security, Winter 1994/95 (Vol. 19, No. 3), pp.5-49.
[17] Zachary S. Davis, " The Realist Nuclear Regime," Security Studies, Vol. 2, Issue 3-4, 1993.

when member states decide " (…) that extraordinary events, related to the subject matter of this Treaty, have jeopardized supreme interests of its country[18]."

North Korea is hitherto the only case of a country that cheated under the Treaty. However, the fact that nuclear weapons allow for rapid shift in the balance of power creates a window of opportunity for the cheating state to inflict a decisive defeat on the victim state. Even though North Korea did not use its nuclear weapons, it opened a terrible precedent: the country benefited from peaceful nuclear cooperation under the auspices of the NPT, developed nuclear weapons and then withdrew from the Treaty. Currently, it is impossible to know how many virtual nuclear powers (VNPs) are willing to follow North Korea`s steps and go nuclear.

In a pessimistic view of the world espoused by realists, " every state would like to be the most formidable military power in the system because this is the best way to guarantee survival in a world that can be very dangerous[19]." If the aim is really to acquire more military power at the expense of the enemy, the NPT might be very attractive. At the same time, the inequality of the NPT is only sustainable if the non-nuclear weapon states are able to develop nuclear technology for peaceful purposes and the nuclear weapon states commit to disarmament, so that the former will not be disadvantaged in the long term. With the right to access the benefits of peaceful nuclear technology comes the responsibility of nonproliferation. Progress on disarmament reinforces efforts to strengthen the nonproliferation regime and to enforce compliance.

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[18] George Bunn and John Rhinelander, " The Right to Withdraw from the NPT: Article X is Not Unconditional, Acronym Website, 1 May 2005, http://www.acronym.org.uk/dd/dd79/79gbjr.htm

[19] John J. Mearsheimer, " The false Promise of International Institutions," International Security, Winter 1994/95 (Vol. 19, No. 3), pp.5-49.

Finally, the challenge nowadays is to fix the NPT pillar that establishes the right to develop a peaceful nuclear program. However, it is hard to strike the right balance between nonproliferation and the development of indigenous nuclear capabilities. In spite of all its failures the world will not look better if the whole nonproliferation regime falls apart. That is exactly what is going to happen if NWS try to prevent the NNWS to benefit from peaceful nuclear cooperation. At the same time, it is hard not to worry when dozens of countries only depend on a political decision in order to go nuclear.

Chapter One

The Emergence of Virtual Nuclear Powers: Do They Pose a Real Threat to the Treaty on the Non-Proliferation of Nuclear Weapons?

Introduction

Since President John F. Kennedy mistakenly predicted that the world would witness unparalleled nuclear proliferation in the 1970s, it is easy to be perceived as an alarmist when one is trying to predict proliferation and the future of atomic weapons. It is important to bear in mind, however, that in 1991, right after the end of the Cold War and the fall of the USSR, the Doomsday Clock was set to 17 minutes to midnight, and the Bulletin of Atomic Scientists declared that "the illusion that tens of thousands of nuclear weapons are a guarantor of national security has been stripped away[20]." As of July 13, 2013 the last edition of the Bulletin of the Atomic Scientists shows that it is five minutes to midnight[21]. Whether the world is more unstable after the end of bipolarity is also a good discussion, but certainly the International Agency of Atomic Energy (IAEA) will have to multiply its efforts in the following years in order to curb nuclear proliferation, since the multipolarity of actors in the international realm and the spread of nuclear technology bring new challenges to the negotiation table.

One of these new challenges is pointed out by Mohamed ElBaradei and investigated in this paper. According to him the spread of uranium and plutonium

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[20] According to the Bulletin of Atomic Scientists, after the end of the Cold War, the U.S. and the USSR begin to cut down their nuclear stockpile. Furthermore, unilateral and multilateral initiatives such as the Strategic Arms Reduction Talks reduce the role of nuclear weapons in both Soviet and American strategies.

[21] Currently the Doomsday Clock also incorporates the threats of global warming and the perils of nuclear power, just like the accident that happened in Fukushima in 2011, for example. There is also the possibility of the use of nuclear weapons in regional conflicts in the Middle East and Asia.

enrichment technologies will result in the proliferation of virtual nuclear powers (VNPs)[22]. How the VNPs affect the non-proliferation regime? They are defined as virtual simply because they will be able to develop nuclear weapons, but they will stop right before assembling them. Thus, at the same time VNPs would be able to run enrichment and processing plants and abide by the rules of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), a phenomenon studied by Albert Wohlstetter in Spreading the Bomb Without Quite Breaking the Rules (Wohlstetter 1976).

This paper argues that the spread of nuclear technology is a trend sustained by the belief that nuclear cooperation for peaceful purposes would inhibit the proliferation of atomic weapons and that this is undermining the crecredibility of the NPT. Currently, the main consequence of that trend is the emergence of VNPs around the globe: they are not nuclear powers, but they have control over the technology necessary to become one. On the one hand they are abiding by the rules of the proliferation regime; on the other hand the NPT alone is not enough to stop their emergence, especially after North Korea decided that it would be worth to pay the price of going nuclear. The multilateral control over the fuel-cycle appeared as a solution to the spread of sensitive technology, which presupposes that Non Nuclear Weapons States (NNWS) should give up their right to develop peaceful technology, while Nuclear Weapons States (NWS) are usually behind nuclear assistance and are not fully committed to disarmament, which is their obligation under the treaty. Therefore, the NPT is losing credibility both because of the spread of nuclear technology and also because to the reaction this trend puts NNWS under the pressure of obligatory Multilateral Nuclear Approaches (MNAs).

[22] "Virtual Nuclear Powers a Looming Threat, ElBaradei Warns," The Guardian, May 2009.

The 2004 IAEA Report of the Secretary`s General High Level Panel on Threats, Challenges and Changes pointed out that at least 40 countries just depend on a political decision in order to go nuclear. This paper asks if the emergence of these VNPs undermines the credibility of the NPT, especially because they are said to be exploring the loopholes in the article IV of the agreement, which establishes one of the three pillars of the NPT and acknowledges the right to use nuclear energy for peaceful purposes. One hypothesis is that this pillar actually leads to nuclear proliferation because it allows countries to develop enrichment technology. In the first part of the paper I will clarify the definition of Virtual Nuclear Powers and the threat they pose to the non-proliferation regime. This first part will also include a theoretical discussion between supply-side and demand side approaches. While the former believe that the decision to go nuclear depends mainly on the access to technology, the latter defends that each state has security needs that will determine whether atomic bombs are necessary to the state`s survival.

In the second part of the paper I will discuss the three pillars of the NPT, highlighting the fact that the pursuit and development of nuclear energy for peaceful purposes is an important part of the bargain between NNWS and NWS. Daniel H. Joyner affirms, for example, that the prevailing interpretation of the treaty undermines the pillar that acknowledges the right to pursue a peaceful nuclear program. Furthermore, he says that world powers are not only imposing harsh conditions on the transfer of civilian nuclear technology, but also prioritizing the non-proliferation pillar of the agreement.[23]I then analyze what motivate countries to acquire nuclear weapons and also the factors behind the two different trends: expansion of nuclear power plants worldwide and

[23]Daniel H Joyner, "Interpreting the Nuclear Non-Proliferation Treaty," Oxford University Press, New York, 2011.

investment in indigenous fuel-cycles. Some analysts affirm that nuclear proliferation is related to the risk of inter-state conflict, which is currently not likely to happen[24].

In the third part of the paper, the objective is to investigate whether nuclear cooperation leads to nuclear proliferation, because the basic idea behind the concept of VNPs is that the spread of nuclear technology gave them the option of going nuclear. Again, it will be necessary to assess the validity of the supply-side theory that advocates that states will choose to build atomic bombs if the transference of technology helps them to overcome the initial hurdles of the nuclear programs. Matthew Furhmann, for example, challenged the belief that the spread of peaceful atomic assistance prevents countries from building the bomb. The author analyzed 2000 nuclear cooperation agreements (NCAs) signed between 1945 and 2000, concluding that proliferation occurs infrequently, but NCAs definitely influence the political decision to build the bomb[25]. Trying to show the other side of the picture, Maria Rost Rublee conducted a research to investigate the reason why states such as Germany, Japan, Sweden, Egypt and Libya had the option to go nuclear, but decided not to carry on military nuclear programs. Even though these states decided to keep their peaceful nuclear programs, their latent belligerent nuclear capability gives them the status of VNPs, since the final decision is political and not technical anymore.

The fourth part of the paper analyzes the impact of the emergence of VNPs on the NPT. The effectiveness of the Treaty depends on the existence of trust between its members and on the grand bargain that stems from the three pillars of the agreement,

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[24] Bruno Tertrais, " The Demise of Ares: The End of War as we know it?," The Washington Quarterly, Summer 2012, p. 7.

[25] Matthew Furhmann, "Spreading Temptation: Proliferation and the Peaceful Nuclear Cooperation Agreements," International Security, 2009.

because NNWS are committed to non-proliferation while NWS are committed to disarmament. However, the regime is losing credibility due to latent proliferation. Moreover, MNAs proposed to solve the proliferation problem affect the pillar of the agreement that is crucial to NNWS and they would place enrichment and reprocessing of nuclear fuel under international control. Rodrigo P. Moreira Penna claims that effective MNAs should be limited, regional, multilayered and non-discriminatory in order to be effective [26]. Many NNWSs simply do not understand the reason why they should give up their right to develop indigenous nuclear fuel-cycles, while NWS are not yet fully committed to disarmament[27].

In order to understand how nuclear cooperation facilitates the political decision to build nuclear weapons, I will analyze the Iraqi nuclear program that shifted from civilian to military status after Saddam Hussein took office and the Iranian nuclear program, whose intent is not clear. I will also analyze the most recent attack to the treaty in a case study apart: the withdrawal of North Korea and the development of its military nuclear program. Some analysts say that North Korea negotiation techniques served, and are still serving, as a model for Iranian officials. In 2007, Sadegh Zibakalam, professor of politics at Tehran University, said that the hard-liner Iranian officials were impressed by North Korea`s achievement, at the negotiation table, and that they are now more inclined to be more resilient and more uncompromising[28]. The declaration makes even more sense

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[26]Rodrigo P Moreira Penna, "Multilateral Nuclear Approaches: Do they provide a credible solution to non-proliferation challenges posed by the expected global expansion of the nuclear power sector?," Meridiano 47, 2010, p.16.

[27] "Interview: Mohamed ElBaradei," Bulletin of the Atomic Scientists, September/October, 2009, vol. 65, no. 5, pp. 1-9.

[28]Kim Murphy, "Analysts in Tehran Call Korea Pact a Model for Iran," Los Angeles Times, February 15, 2007, Accessed July 10, 2013.
http://www.sfgate.com/politics/article/Analysts-in-Tehran-call-Korea-pact-a-model-for-2648963.php

when we think that the Iranian leadership is playing for an internal audience that has not much contact with the rest of the world and that is not willing to see the U.S. dictating Iran`s behavior, but rather negotiating among equals. The question that remains unanswered is who is going to be the next one to step up to the plate and withdraw from the agreement?

The world is not the same after nuclear weapons were invented. It is amazing to imagine that the use of an atomic bomb during World War II inspired such terror worldwide that it impelled a large group of countries to give up their nuclear belligerent ambitions if a small group of countries commit to disarmament. On the one hand, the NPT can be considered a history of success that comprises 190 signatories; on the other hand many analysts consider the treaty to be currently under strain and not capable to cope with the challenges of the 21st century[29].

Virtual Nuclear Powers

As of September 1985, a few days after the end of the Third Review Conference on the NPT, Paul Leventhal was already calling attention to the perils of latent proliferation. He argued that by signing the treaty and agreeing with its terms countries would have access to sensitive nuclear technology to begin their civilian nuclear programs, a right acknowledged by article IV of the agreement[30]. His preoccupation is

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[29] Jan Ruzicka, and Nicholas J Wheeler, "*The Puzzle of Trusting Relationships in the Nuclear Non-Proliferation Treaty*," International Affairs, 2010, p. 69.

[30] ARTICLE IV
1. Nothing in this Treaty shall be interpreted as affecting the inalienable right of all the Parties to the Treaty to develop research, production and use of nuclear energy for peaceful purposes without

explained by the fact that plutonium is a waste product of reactors that can become an explosive after it is separated from spent fuel in reprocessing plants, while highly enriched uranium (HEU) is produced in enrichment plants and used as fuel in research reactors and in nuclear power plants. Suddenly, the world was witnessing NPT parties having access to fissile material that could be diverted from nuclear power plants to build atomic warheads, without violating any commitments of the non-proliferation regime. Thus, more than two decades ago, Leventhal and Wohlstetter were beginning to define the concept of VNPs.

In 2009, by the end of his tenure as IAEA Director General, Mohamed ElBaradei gave an interview to The Guardian warning the world that "virtual nuclear powers were a looming threat[31]." According to him the world would soon witnesses the emergence of at least 20 nations with the expertise and materials needed to build nuclear weapons. Besides the spread of nuclear technology, the former Director General said that the trend would be exacerbated by the inability of the NPT to push its parties for more ambitious commitments. He was probably trying to say that it would be hard to convince NNWS not to go nuclear, especially those states located in conflict regions, while the five recognized NWS were slowing down the pace of nuclear disarmament and modernizing and improving their nuclear stockpiles.

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discrimination and in conformity with Articles I and II of this Treaty.
2. All the Parties to the Treaty undertake to facilitate, and have the right to participate in. the fullest possible exchange of equipment, materials and scientific and technological information for the peaceful uses of nuclear energy. Parties to the Treaty in a position to do so shall also cooperate in contributing alone or together with other States or international organizations to the further development of the applications of nuclear energy for peaceful purposes, especially in the territories of non-nuclear-weapon States Party to the Treaty, with due consideration for the needs of the developing areas of the world.

[31] " Virtual Nuclear Powers a Looming Threat, ElBaradei Warns," The Guardian, May 2009.

Since 1985, many predictions about nuclear proliferation have been made and many of them were wrong, challenging beliefs and crystallized perceptions of the international community. Who would believe, for example, that Taiwan and South Korea would gave up their nuclear weapons programs after harsh negotiations with the U.S? By that time the only members of the nuclear club were the United States, the Soviet Union, the United Kingdom, China and France and the non-proliferation regime comprised only 127 nations. Many states suspected of building the bomb or considered to be on the verge of it were also outside the treaty, such as Brazil, Argentina, South Africa, India, Israel and Pakistan. Currently, the nuclear club undesirably expanded and counts with the presence of nine associates, one of them - North Korea – was the first country ever to withdraw from the treaty. Moreover, evidence shows that the North Korean nuclear program was being developed while the country was still party to the agreement. At least there were improvements as well: Brazil, Argentina and South Africa phased out their nuclear programs in the 1990s, even though the three countries were in different stages of their nuclear projects.

The very concept of VNP implies that NNWS may violate the treaty one day, deciding to go nuclear and that one of the pillars of the NPT, which acknowledges the right to pursue the development of nuclear programs for peaceful purposes, is actually responsible for the spread of sensitive nuclear technology. Furthermore, the concept itself is underpinned by the supply-side approach that holds that countries that receive nuclear assistance will overcome the initial obstacles of a military nuclear program. According to Matthew Kroenig, for example, states that receive assistance "can leapfrog technical design stages, acquire tacit knowledge from more advanced scientific communities,

economize on the costs of nuclear development, and avoid international pressure to abandon a nuclear program[32]".

It is important to stress, however, that most of the literature on nuclear proliferation is based on demand-side approaches, which argue that states will look for atomic weapons if they are willing to do so and not if they have the opportunity. Usually the willingness depends on three factors: the security environment of the state and its necessity to deter external aggression; political lobbies that can foster the development of nuclear programs due to distorted worldview and other provincial reasons and also states that are in search of international prestige[33]. However, willingness, isolated from other factors, does not lead to the development of an expensive and technologically complex nuclear weapons program. Especially in developing countries where the resources are scarce and the trade-off is big. In a press conference in 1965, Zulfikar Ali Bhutto, the father of the Pakistani nuclear program, once declared that "we will eat grass or leaves, even go hungry, but we will get one of our own. We have no alternative.[34]" The Pakistani nuclear program shows the perfect combination of necessity and foreign nuclear assistance: the Indo-Pakistani war resulted in the loss of a big chunk of territory and of millions of citizens that were incorporated to India, an episode that changed the nature of the Pakistani nuclear program. In the beginning of the 1980s, China transferred uranium-enrichment technology and personnel to Pakistan. The Chinese technicians remained in

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[32]Matthew Kroenig, "Importing the Bomb: Sensitive Nuclear Assistance and Nuclear Proliferation," *Journal of Conflict Resolution*, 2009, p. 162.

[33]Scott D Sagan, "Why do States Build Nuclear Weapons?" Three Models in Search of a Bomb, International Security 21, pp.54-86.

[34] House Republican Committee, House of Representatives, *" Pakistan`s Assertive Regional Strategy – From the Task Force on Terrorism and Unconventional Warfare,"* Washington, DC, Aug 24, 1994. Accessed July 14, 2013. http://www.fas.org/irp/congress/1994_cr/h940912-pak.html

the country until the enrichment facility was fully operational and in 1984 the country was capable to assemble atomic weapons[35].

If the supply-side approach is correct and nuclear assistance really gives rise to VNPs, one of the most important pillars of the treaty is affected and that can generate unprecedented crisis, since the NPT itself would be based on wrong premises. Looking back a few decades ago it is clear that many expectations concerning nuclear proliferation were frustrated, while some trends were confirmed. The Nuclear Cooperation Agreements that led to the expansion of the nuclear club were an expected result, since nuclear weapons are still envisaged as game changers and supreme guarantors of security[36]. In this sense, it is not wrong to suppose that states that have their existence threatened will want to develop the most powerful weapons ever invented, if they have the opportunity. All the five countries that acquired the bomb outside the nuclear weapons club – Israel, Pakistan, India, North Korea and South Africa – had to rely on foreign assistance to shift from VNPs to nuclear powers[37]. The fact that North Korea developed its military program while being a party to the NPT only proves the validity of the term and the threat that it poses to the non-proliferation regime.

The Grand Bargain: the Pillars of the Treaty on the Non-Proliferation of Nuclear Weapons

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[35] Rodney W. Jones, and Mrk G. McDonough with Toby F. Dalton and Gregory D. Koblentz. "Tracking Nuclear Proliferation: A Guide in Maps and Charts," Carnegie Endowment for International Peace, Washington, DC 1998, pp. 50-57

[36] "Interview: Mohamed ElBaradei," Bulletin of the Atomic Scientists, September/October, 2009, vol. 65, no. 5, pp. 1-9.

[37] Matthew Furhmann, "Spreading Temptation: Proliferation and the Peaceful Nuclear Cooperation Agreements," International Security, 2009, pp. 15-41.

Since the U.S. tested its first nuclear device at Alamogordo, New Mexico, in 1945, the international community has been trying to find the right balance between the benefits of nuclear energy and the horrors of the atomic bomb[38]. The NPT is an attempt to regulate the positive and negative aspects of nuclear energy, which can lead mankind to progress or to total destruction at the same time. In this sense, the regime tried to freeze the reality of the 1960s creating two different clubs: one frequented by the five Nuclear Weapon States (NWS) and the other frequented by Non Nuclear Weapon States (NNWS). Such obvious inequality could only be sustained by the so-called grand bargain that rests on three pillars: nonproliferation, peaceful use of nuclear energy and disarmament. The VNPs threat the stability of the regime because the side effects of the civilian nuclear programs allow them to have access to technology and fissile materials to build bombs if they wish.

According to article I, NWS are committed to nonproliferation, since they cannot transfer nuclear weapons to any country nor help NNWS to acquire or build these nuclear devices. In this sense, it is important to make clear that the NPT defines a NWS as a state that produced and exploded a nuclear device prior to 1 January, 1967. As mentioned these states are Russia, U.S., United Kingdom, China and France, even if the two last countries only ratified the treaty in the 1990s. All other countries are considered to be NNWS under the treaty. Under article II, NNWS are committed to not acquire or produce nuclear weapons and article III states that they will have to accept IAEA safeguards to oversee their nuclear programs.

[38] Department of State, " Treaty on the Non-Proliferation of Nuclear Weapons," US Delegation to the 2010 Nuclear Nonproliferation Treaty Review Conference.

Article IV is a case apart because it is intrinsically related to the emergence of the VNPs and it is also an important part of the bargain that sustains the NPT. If Stephen Walt and the realists are right and power and security, the two basic tenets of the realist tradition, are the main forces behind states` behavior, then no country would accept a position of inferiority in relation to NWS just because the world is safer with less nuclear weapons in the international arena[39]. That is the reason why the inalienable right to develop a peaceful nuclear program was considered to be an incentive to non-proliferation: the have-nots would agree to remain disarmed if they could at least make use of nuclear energy to offer better life conditions to their population. Nobody could expect at that time that the spread of nuclear technology would also tempt some states to go nuclear.

The inalienable right, however, is considered to be rather ambiguous by some analysts[40]. According to article IV, "nothing in this treaty shall be interpreted as affecting the inalienable right of all the parties to the treaty to develop research, production and use of nuclear energy for peaceful purposes without discrimination and in conformity with articles I and II of this treaty." In the 1970 Pierre Lellouche pointed out, for example, that article IV was a guarantee that NNWS would have access to the entire nuclear cycle[41]. Fully aware of the implications of a loose article IV, Joseph Nye, as a Carter Administration Senior Official in charge of non-proliferation, emphasized that the inalienable right should always be interpreted in conformity with articles I and II of the

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[39]Stephen M Walt, "International Relations: One World, Many Theories," Foreign Policy, 1998.
[40] Zhang Xinjun, " The Riddle of Inalienable Right in Article IV of the Treaty on the Non-Proliferation of Nuclear Weapons: Intentional Ambiguity," . Oxford University Press, 2006), pp. 647-651.

[41]Pierre Lellouche, "Breaking the Rule Without Quite Stopping the Bomb: European Views," *35 International Organization*, 1981.

treaty, which tried to prevent transfer, production and purchase of nuclear weapons or any other explosive devices[42]. Joseph Nye`s statement may sound obvious nowadays, but in that same period Bertrand Goldschmidt, then former chairman of the Board of Governors of the IAEA, declared that any restrictions on transmission of sensitive nuclear activities were incompatible with the NPT[43].

A few decades after that theoretical war, article IV continues to be controversial and affirmed as an inalienable right. Iran is always declaring that its nuclear program is peaceful[44], despite the fact that the country has been improving its enrichment technology and has already developed a significant amount of Low enriched Uranium and 20% enriched uranium, which it is almost 90% of the way necessary to produce weapons grade uranium according to specialists[45]. The Iranian dilemma and the fear of another case of withdrawal from the NPT, just like happened to North Korea a few years ago, are contributing to make the multilateral approach to the nuclear cycle more popular. Mohamed ElBaradei once declared that "if you`re not going to produce nuclear weapons, you shouldn`t have any problems with the whole nuclear fuel cycle being under multinational control[46]." If the emergence of VNPs undermines one of the pillars of the regime, the Multilateral Nuclear Approaches (MNAs) will also create controversy, because they affect the inalienable right of the NNWS.

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[42] Joseph S Nye, "The International Nonproliferation Regime," *Stanley Foundation*, 1980.
[43] Bertrand Goldschmidt, "Nuclear Non-Proliferation and Safeguards, A Conference Report," The Atlantic Institute for International Affairs, The American Nuclear Society, 1981.
[44] Paul K. Kerr, "Iran`s Nuclear Program: Status," *Federation of American Scientists,* 2012, accessed 17 July, 2013,http://www.fas.org/sgp/crs/nuke/RL34544.pdf
[45]Wyn Q Bowen and Jonathan Brewer, "Iran`s Nuclear Challenge: Nine Years and Counting," *International Affairs*, 2011.
[46] "Interview: Mohamed ElBaradei," Bulletin of the Atomic Scientists, September/October, 2009, vol. 65, no. 5, pp.1-9.

Besides the ambiguity of article IV[47], the very definition of nuclear proliferation under the NPT may be considered controversial. In 1985, Paul Leventhal explained that nuclear proliferation is defined more in terms of explosions and acquisition of explosive devices rather than in terms of materials, such as HEU and separated plutonium[48]. If the use of these materials are intended for peaceful purposes and placed under the safeguards, there is no violation of the treaty. According to him, the "Treaty does not restrict – indeed it promotes – transfers of spent-fuel reprocessing and uranium enrichment materials." The proliferation potential of reactors is clear when we bear in mind that 01 megawatt-day of operation produces 1 gram of plutonium in any reactor using 20% or lower enriched uranium and a 100 (MW (t) reactor produces 100 grams of plutonium per day. Therefore, it could produce enough plutonium for one weapon every two months[49].

The three pillars of the NPT are supposed to be interconnected in such a way that they reinforce each other effectiveness. If the access to nuclear technology for peaceful purposes increases the risk of proliferation, then at least two pillars of the grand bargain are being affected. Ironically, NNWS can still declare that they are fulfilling their obligations under the regime. North Korea is an exception and it is really hard to prove that Iran has a nuclear weapons program. What about the pillar related to disarmament? According to the latest research of the Federation of American Scientists the total inventory of nuclear weapons is currently around 17,300. Despite the efforts to decrease

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[47] Zhang Xinjun*, "The Riddle of Inalienable Right in Article IV of the Treaty on the Non-Proliferation of Nuclear Weapons," Intentional Ambiguity.* Oxford University Press, 2006, pp. 647-651.

[48] Paul Leventhal, "Flaws in the Non-Proliferation *Treaty,"* Bulletin of the Atomic Scientists, 1985.
[49] John Pike, "Plutonium Production," Federation of American Scientists, updated Tuesday, June 20, 2000. Accessed July 17, 2013. http://www.fas.org/nuke/intro/nuke/plutonium.htm

their nuclear stockpiles, the U.S. and Russia account together for 16,200 warheads. The two countries that set the pace of nuclear disarmament are

also spending millions of dollars to modernize their stockpiles and to develop better delivery systems. Many NNWS considered the pace of disarmament to be slow. The following table shows the current status of world nuclear forces worldwide[50]:

Status of World Nuclear Forces Early-2013*

Country	Operational Strategic	Operational Nonstrategic	Reserve/ Nondeployed	Military Stockpile	Total Inventory
Russia	1,800[a]	0[b]	2,700[c]	4,500	8,500[d]
United States	1,950[e]	200[f]	2,500[g]	4,650	7,700[h]
France	290	n.a.	?[i]	300	300
China	0[j]	?[j]	180	250	250[j]
United Kingdom	160[k]	n.a.	65	225	225[k]
Israel	0	n.a.	80	80	80[l]
Pakistan	0	n.a.	100-120	100-120	100-120[m]
India	0	n.a.	90-110	90-110	90-110[n]
North Korea	0	n.a.	<10	<10	<10[o]
Total:[p]	**~4,200**	**~200**	**~5,700**	**~10,200**	**~17,300**

In the words of Michael Keks[51], the inequality of the NPT is only sustainable if the NNWS are able to develop nuclear technology for peaceful purposes and the NWS commit to disarmament, so that the former will not be disadvantaged in the long term. This section shows, however, a lack of interconnection between these two pillars. On the one hand, the fact that article IV is ambiguous and the definition of nuclear proliferation

[50] *" Status of World Nuclear Forces Early-2013," Federation of American Scientists*, last update early 2013. Accessed 18 July,2013. http://www.fas.org/programs/ssp/nukes/nuclearweapons/nukestatus.html

[51] Michael Keks, "Nuclear Weapons, Global Disarmament and the Grand Bargain: the Nuclear Non-Proliferation Treaty into the Twenty-First Century," *Ethos*, 2011, pp. 26.

is loose may have contributed to the spread of HEU and plutonium all over the world. On the other hand, NWS are not fully committed to nuclear disarmament.

Nuclear Cooperation and Nuclear Weapons Proliferation

If the supply-side theory approach is correct and nuclear cooperation results in nuclear weapons proliferation, or at least it allows for the emergence of the VNPs, it is possible to surmise that the NPT contained the seeds of its own destruction and the Atoms for Peace speech actually contributed to nuclear arms race[52]. President Dwight Eisenhower had, of course the best of intentions and was trying to find "the way by which the miraculous inventiveness of man shall not be dedicated to his death, but consecrated to his life." Not only was the speech one of the first calls against nuclear proliferation, but also inspired the creation of the IAEA in 1956. Since his remarkable address before the United Nations General Assembly in December 1953, however, most analysts believe that nuclear cooperation for peaceful purposes does not lead to nuclear weapons proliferation.

According to some analysts, very few states feel compelled to acquire nuclear weapons and that explains the reason why just a few of them went nuclear almost seven decades after the invention of atomic weapons. As it was mentioned in this paper, the demand-side approach declares that states will resort to nuclear weapons if they want to and not if they have the opportunity. Some authors even say that atomic weapons made sense during the Cold War period, when there was the possibility of war between states. Currently, the only risk of war resides in sub-state conflicts, usually caused by ethnic

[52] Matthew Furhmann, "Spreading Temptation: Proliferation and the Peaceful Nuclear Cooperation Agreements," International Security, 2009, p.40.

disputes [53]. Therefore, nuclear weapons would be something inherited from the Cold War and served well for deterrence purposes during bipolarity era, when the U.S. and the USSR were able to convince their allies of the benefits of not going nuclear and staying under the protection of their leadership.

Another interesting point raised by demand-side approach analysts is that the nonproliferation regime was able to create a taboo against nuclear weapons that is easily verifiable. The last time they were used in conflict was in Hiroshima and Nagasaki during World War II. The terrible aftermath of the atomic explosions in Japan and the development of the non-proliferation regime only contributed to increase the political costs of the use of nuclear weapons. Christoph Bluth shows that the diffusion of international norms inhibits most states from using nuclear weapons and from even trying to acquire them. Furthermore, the dynamics of war are also changing from intrastate conflict to interstate conflicts and nuclear weapons represent a huge investment that would only be used for deterrence. Even from a quantitative point of view it is easy to see that most countries decided to adhere to the nonproliferation efforts. Even countries such as Germany and Japan decided not to build the bomb, despite their capacity to do so. Moreover, the use of force in international relations is not as legitimate as it was in the 19th century and in the beginning of the 20th century[54].

It is undeniable that many countries still envisage nuclear weapons as supreme guarantors of their security[55]. In order to get the ticket to the nuclear energy club, for

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[53]Christoph Bluth, "The Irrelevance of Trusting Relationships in the Nuclear Non-Proliferation Treaty: Reconsidering the Dynamics of Proliferation," The British Journal of Politics and International Relations, 2012, p. 119.
[54]John Mueller, "Retreat From Doomsday: The Obsolescence of Modern War," *Basic Books,* New York, 1989.
[55] "Virtual Nuclear Powers a Looming Threat," ElBaradei Warns, The Guardian, May 2009.

example, Iran spent at least $ 11 billion in the construction of its Busheshr reactor, which took almost four decades to complete and is one of the most expensive of its kind. Currently the reactor produces 2% of Iran`s electricity needs, while 15 % of the country`s generated electricity is lost through old and ill-maintained transmission lines[56]. Maybe Iran is an exceptional case because its nuclear project has been dragging on for decades, but the fact is that according to some studies nuclear assistance helps to overcome initial hurdles and makes the decision to go nuclear easier[57]. Furthermore, nuclear technology is still expensive but it is getting cheaper everyday. According to Matthew Kroenig, for example, countries receiving enrichment and reprocessing facilities, bomb designs, or significant quantities of weapons-grade fissile material are more likely to acquire the bomb[58].

In his work *Importing the Bomb: Sensitive Nuclear Assistance and Nuclear Proliferation*, Matthew Kroenig also stresses that the initial hurdles of a nuclear program can be broken down in four different phases. First of all, it is costly for states to go after some nuclear technologies such as uranium enrichment plants and implosion type nuclear weapons, because they are very sophisticated and hard to design indigenously. Second, the construction and operation requires numerous attempts that usually result in failure. He cites, for example, that Iraq tried to produce HEU in many different ways before deciding on electromagnetic isotope separation (EMIS). Iraqi engineers also tested

[56]Karim Ali Vaez Sadjadpour, "Iran`s Nuclear Odissey: Costs and Risk," Carnegie Endowment for International Peace, 2013.
[57] Matthew Kroenig, "Importing the Bomb: Sensitive Nuclear Assistance and Nuclear Proliferation" *Journal of Conflict Resolution*, 2009, 164-165.
[58]Ibid.

gaseous centrifuge, chemical enrichment, ion exchange and laser isotope separation[59]. The third obstacle refers to the costs involved in the development of a nuclear infrastructure, especially when countries do not have all the necessary means available at home. In its attempt to build nuclear weapons, it is known that Iraq had to partner with many western companies and spent billions of dollars unsuccessfully. Finally, the last obstacle refers to the international political pressure involved in the attempt to move from a peaceful nuclear program to military one. Sometimes this political pressure results in military strikes such as the Israeli strike that destroyed the Osirak reactor in Iraq and the Al Kibar nuclear reactor in Syria [60].

After overcoming the three initial obstacles highlighted by Matthew Kroenig it is already possible to say that the country is a VNP, since the decision to go nuclear will only face political difficulties not technical ones. Once again, the Iraq case study is illustrative. Hussein al-Shahristani, Iraqi nuclear scientist and politician, once said that Saddam Hussein changed the nature of Iraq`s nuclear program right after assuming the country leadership in 1979. The scientist also revealed that Western companies assisted the country to enrich uranium to weapons grade. Actually, Iraq came close to enrich uranium to 93 percent. According to him those companies also helped Iraq to develop "complex detonation devices crucial to the successful explosion of a nuclear weapon [61]." The NTI website highlights the fact that Hussein al-Shahristani escaped from prison during the Gulf War and the date and location of his declaration were not given. His

[59] Nuclear Threat Initiative (NTI), "Iraq Nuclear Chronology," NTI Website, last updated, 2009, Accessed July 20, 2013. http://www.nti.org/media/pdfs/iraq_nuclear.pdf?_=1316466791
[60] "The Story of Operation Orchard: How Israel Destroyed Syria Al Kibar Nuclear Reactor ," Spiegel Online International, 2009, Accessed July 20, 2013. http://www.spiegel.de/international/world/the-story-of-operation-orchard-how-israel-destroyed-syria-s-al-kibar-nuclear-reactor-a-658663.html
[61] Darwis Ghalih, "Scientist Views Iraq`s, Iran Nuclear Programs," London, Al-Majallah, 28 January, 1996, pp. 22-24.

interview shows how important international nuclear cooperation is for a country that is deciding to move from the status of VNP to nuclear power. His personal life also demonstrates how a young student with exceptional aptitude for science had to study abroad to develop certain skills and acquire the knowledge necessary to design and build nuclear reactors[62].

The Iraq case is just one example of how nuclear cooperation and proliferation are intertwined due to the dual-use nature of technology and know-how [63]. Matthew Fuhrmann goes a little bit further in his analysis and establishes a direct relationship between what he calls peaceful nuclear cooperation and nuclear weapons proliferation, analyzing 2,000 NCAs signed from 1945 to 2000[64]. He concludes that "nuclear aid increases the likelihood of acquiring the bomb by about 360 percent; the combination of atomic assistance and militarized disputes increases the probability of building nuclear weapons by 750 percent." It is possible to infer that the demand-side approach does not provide a complete explanation for nuclear proliferation, but it is determinant when combined with access to nuclear technology expertise. However, this relationship is probabilistic not deterministic, simply because not all recipients of assistance will cross the nuclear threshold [65]. The author also concluded that 78% of the nuclear power states received some sort of assistance and no country acquired nuclear weapons without receiving aid from 1953 to 2000.

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[62] "Shahristani, Architect of Iraq Oils Future," *Reuters*, 2010, accessed July 20, 2013. http://in.reuters.com/article/2010/12/18/idINIndia-53656120101218

[63] Matthew Kroenig, "Importing the Bomb: Sensitive Nuclear Assistance and Nuclear Proliferation," Journal of Conflict Resolution, 2009.

[64] Matthew Furhmann, "Spreading Temptation: Proliferation and the Peaceful Nuclear Cooperation Agreements, International Security, 2009, p.32.

[65] Sonali Singh and Christopher R Way. "The Correlates of Nuclear Proliferation: A Quantitative Test," *Journal of Conflict Resolution*, 2004.

The work of Matthew Fuhrmann is crucial to understand how article IV of the NPT was determinant to consolidate the era of the VNPs. While only France, U.S. and the United Kingdom began their programs without any kind of cooperation, all the other nuclear powers received civilian assistance. How many countries will begin their military nuclear programs and change their status from VNP to nuclear power states only depends on the fragile stability of the international system. Once the nuclear infrastructure is installed the decision to go nuclear will depend on demand-side considerations, such as a state`s security environment, international norms and political motivations [66]. The irony behind article IV is that international community has been behaving as though peaceful atomic assistance would lead the world towards effective arms control policy and not to nuclear proliferation [67]. In this sense, the nuclear assistance paved the way for the emergence of VNPs, undermining one of the main pillars of the NPT.

Credibility of the Treaty on the Non-Proliferation of Nuclear Weapons

In 2005, Mohamed ElBaradei said that the NPT has been sufficient to prevent nuclear proliferation for the past three decades, but in order to continue to exist it must adapt to the new challenges imposed by a changing international system [68]. The former Director General has been warning the international community about new threats such as the spread of sensitive nuclear know-how that leads to the emergence of the VNPs; the

[66]George H Quester, "The Politics of Nuclear Proliferation," The Johns Hopkins University Press. 1973.
[67] Matthew Furhmann, "Spreading Temptation: Proliferation and the Peaceful Nuclear Cooperation Agreements," International Security, 2009, pp. 39-41.
[68]" Statements of IAEA Director General Dr Mohamed ElBaradei in 2005 Review Conference of the Treaty on the Non-Proliferation of Nuclear Weapons," IAEA, 2005. http://www.iaea.org/newscenter/statements/2005/ebsp2005n006.html

uneven degree of physical protection of nuclear materials from country to country; the limitations of IAEA safeguards; the reliance on nuclear deterrence and the mistrust relationship between NWS and NNWS. Zhang Xinjun explained that "a treaty is not a finished product but a matter under continual construction by consensual method[69]" and multilateral talks are already trying to catch up to the new realities that put the regime under strain.

At this point of the paper it is clear that the emergence of VNPs is closely related to the spread of nuclear technology, an inalienable right acknowledged under article IV of the NPT. In order to restore credibility in the non-proliferation regime it is necessary to fix one of its pillars and the problem is that it will cause more mistrust, since it affects the grand bargain that sustains the whole regime. As traditional non-proliferation mechanisms such as safeguards and export controls were not sufficient to prevent the spread of nuclear technology, the solution to control the emergence of VNPs is to put centers for the enrichment and reprocessing of nuclear fuel under international control, the so called Multilateral Nuclear Approaches (MNAs)[70]. Moreira Penna explains that comprehensive MNAs have already been suggested to prevent nuclear proliferation. The Global Nuclear Energy Partnership (GNEP), for example, is based on fuel leasing and suppliers are supposed to provide nuclear fuel and buy it back for disposal or reprocessing, while the Six-State Assurance of Supply, a joint effort that involves U.S., France, Germany, Russia, UK, and the Netherlands, is a initiative that guarantees a

[69], Zhang Xinjun, "The Riddle of Inalienable Right in Article IV of the Treaty on the Non-Proliferation of Nuclear Weapons: Intentional Ambiguity," . Oxford University Press, 2006, p.650.

[70] Rodrigo P Moreira Penna, "Multilateral Nuclear Approaches: Do they Provide a Credible Solution to Non-Proliferation challenges Posed by the Expected Global Expansion of the Nuclear Power Sector?," Meridiano 47, 2010, p.15.

constant fuel supply by one of the countries [71]. Some countries are also beginning to develop regional enrichment projects. In 2008, for example, Brazil and Argentina have signed a bilateral agreement to begin a joint uranium enrichment program [72].

Some specialists believe that MNAs are not a reality because of mistrust, since NNWS do not understand why they should give up their indigenous nuclear fuel-cycle programs while NWS are not fully committed to disarmament. The matter illuminates the fragile balance between NWS and NNWS and stresses the importance of trusting relationships to the non-proliferation regime. That is maybe the reason why states choose to build their own fuel cycles even when that is not the most rational economic option. According to some specialists, buying small quantities of enriched uranium is cheaper than investing in indigenous uranium enrichment facilities. Decker and Michel-Kerjan also stress, however, that countries have at least three good reasons to try to enrich their own uranium: "(I) a fuel cycle ability provides more commercial and political stability to the nuclear reactors` fuel supply, which in turn lowers the expected discounted cost of the total electric power per kilowatt-hour delivered; (II) while providing an assured source of supply, an enrichment facility can also cover part of its cost by providing enrichment services to other countries and other reactors (including research reactors); (III) the enrichment capability is often viewed as providing increased prestige and power, and allows for the option of a possible breakout to nuclear weapon capabilities [73]."

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71 Ibid, 18.

72 "Brasil e Argentina Assinam Pacto para Enriquecer Urânio," *Folha de São Paulo*, February 23, 2008. Accessed July 21, 2013. http://www1.folha.uol.com.br/fsp/brasil/fc2302200802.html

73 Debra K. Decker and Erwann O. Michel-Kerjan, "A New Energy Paradigm: Ensuring Nuclear Fuel Supply and Nonproliferation through International Collaboration with Insurance and Financial Markets," Risk Management and Decision Processes Center, The Wharton School of the University of Pennsylvania, March 2007.

It is not possible to talk about the problem of trust in the non-proliferation regime without citing the study of Jan Ruzicka and Nicholas J. Wheeler, who argue that the grand bargain of the NPT is also underpinned by trusting relationships. The authors define trusting relationships as "one into which actors enter knowing that as a consequence they increase their vulnerability to other actors whose behavior they do not control, with potentially negative consequences for themselves[74]." They also argue that the main reason for distrust among the members of the NPT is the spread of civil nuclear cycles and "the weaponization possibilities they bring", since at least 40 governments could start their military nuclear programs if they decide to do so [75]. The fact that the NWS still rely heavily on nuclear weapons for their security also has a direct impact on the behavior of NNWS, contributing to spread the feeling of distrust among those who do not have atomic bombs, but see no reason not to exercise the right acknowledged under article IV: the right to develop indigenous fuel-cycle capabilities [76].

The pessimistic view espoused by Jan Ruzicka and Nicholas J. Wheeler is not supported by Christoph Bluth, for example. He highlights the fact that most states do not believe that nuclear weapons are required for their security, especially because the decision to go nuclear has heavy political consequences nowadays and the nature of conflicts has changed after the end of Cold War [77]. Moreover, atomic weapons are not so useful in the intrastate conflicts that prevail in the 21st century. The author also stresses

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[74] Jan Ruzicka and Nicholas J Wheeler, "The Puzzle of Trusting Relationships in the Nuclear Non-Proliferation Treaty, International Affairs, 2010, p.70.

[75] "A More Secure World: Our Shared Responsibility," Report of the Secretary-General`s High Level Panel on Threats, Challenges and Change, December 2004.

[76] Jan Ruzicka and Nicholas J Wheeler, "The Puzzle of Trusting Relationships in the Nuclear Non-Proliferation Treaty,"International Affairs, 2010.

[77] Christoph Bluth, "The Irrelevance of Trusting Relationships in the Nuclear Non-Proliferation Treaty: Reconsidering the Dynamics of Proliferation," The British Journal of Politics and International Relations, 2012, p.119.

that NPT has a solid history of success, with its 191 members, and nuclear proliferation is actually very rare. According to him, "what is required to sustain the NPT is not the building of trust, but reassurance. Reassurance does not involve the voluntary acceptance of vulnerability, but rather the reduction in vulnerability vis-à-vis potential adversaries."

The North Korean nuclear program is a typical case of peaceful nuclear cooperation that resulted in a nuclear weapons program. North Korea joined the Treaty in 1985 and decided to withdraw in 2003, after using the membership to develop a nuclear weapons program, which culminated in nuclear tests in 2006, 2009 and 2013[78]. Furthermore, the country has been using its status as nuclear power to try to gain more political leverage in international negotiations, making threats in order to bargain. The North Korean strategy has also been defined as a model for Iranian negotiators, who quickly learned that they should be hard bargainers and use contentious strategy [79]. At that time the Iranian scholar Sadegh Zibakalam once declared that "this scenario has been at the back of the minds of some Iranian leaders: that if we reach a stage that we would be respected as an equal partner, then we could do real negotiations and reach a deal over our nuclear program."

With regard to the Iranian nuclear program, some analysts say that the country is not investing in the development of nuclear weapons, since it just want to have control over the complete nuclear cycle enrichment. That is the very concept of VNP. According to some reports, the Iranian nuclear program has some controversial parts such as the

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[78] "North Korea Country Profiles," Nuclear Threat Initiative (NTI), NTI website, last update May 2013. Accessed July 22,2013. http://www.nti.org/country-profiles/north-korea/

[79] Kim Murphy, "Analysts in Tehran Call Korea Pact a Model for Iran," *Los Angeles Times*, February 15, 2007. Accessed July 10, 2013. http://www.sfgate.com/politics/article/Analysts-in-Tehran-call-Korea-pact-a-model-for-2648963.php

VVER-1000 MWe light water reactor at Bushehr, a uraniuam conversion facility at Esfahan, enrichment facilities at Natanz and Qom, a heavy water production plant and a heavy water research reactor under construction in Arak[80]. When questioned about the possible military dimension of its program, Iranian officials usually argue that the country has the inalienable right to develop peaceful nuclear technology.

In order to understand how the credibility of the non-proliferation regime is under strain it is important to highlight the fact that the loopholes that allow countries to become VNPs are generating distrust among signatories. At the same time, NWS feel obliged to react to the latent perils of nuclear cooperation and are proposing the MNAs that would put the nuclear fuel-cycle under international control. Therefore, if many countries already depend on the benefits of extended deterrence in order to survive, now they will have to trust that other countries will supply them with all the uranium they need for their reactors. All the situation leads to a cycle of distrust among the signatories that undermines the grand bargain that sustains the Treaty.

Case Study: North Korea

In hindsight, North Korea`s decision to go nuclear makes sense and looks quite obvious: the authoritarian communist regime, with perceived international enemies, have decided to initiate a civilian nuclear program by the end of the 1950s, under the auspices of the Soviet government, and finally conducted its first nuclear test a few decades later, in 2006, after withdrawing from the NPT. After weighing the pros and cons North Korea decided to shift its status from VNP to a real nuclear power and struck a blow against the

[80] "Iran Country Profiles," Nuclear Threat Initiative (NTI), NIT website, last update July 2013. Accessed July 22,2013. http://www.nti.org/country-profiles/iran/

non-proliferation regime, exposing all vulnerabilities of the Treaty: the article IV that helped develop a military nuclear program; the safeguards that did not prevent nuclear proliferation; the withdrawal clause that was convenient to hide North Korean real intentions.

The North Korean case demonstrates how the signing of a peaceful nuclear cooperation with the Soviets in 1959 wound up in the acquisition of the bomb a few decades later. The USSR trained North Korean nuclear scientists in the 1950s and helped to build the Yongbyon nuclear complex in 1962[81]. The Soviet aid allowed the country to operate its nuclear weapons program in 1983, when the Yongbyon complex was employed to produce plutonium that would be used later to conduct its first nuclear test[82]. As it was predicted by the supply-side approach the assistance helped the country to overcome its initial hurdles. Acquiring fissile material – plutonium-239 or highly enriched uranium (HEU) – is the main obstacle in a military nuclear program. According to some specialists the production of these two materials is hard while weaponization is considered to be relatively easy. Some reports indicate that Chinese companies have been supplying key components and raw materials for North Korea`s missile program since 1999[83]. Currently, the country has rockets Unha to launch satellites, short range Scud-

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81 Mun Suk Ahn, "What is the Root Cause of the North Korean Nuclear Program?,"Asian Affairs, An American Review, 2011, 178.

82 Hyung Hyuk-kyu, "Causes of North Korea`s Nuclear Program and Possible Solutions Revisited: Limitation of the Songun," *Military First, Policy and Changing North Korea`s Security Strategies* , National Assembly Library Review, 2007, p.90.

83 Larry A Niksch, "North Korea`s Nuclear Weapons Program," CRS Brief for Congress, April 7, 2006, p. 9.

Class, medium range Nodong ballistic missiles and is improving an intermediate range ballistic missile[84].

North Korea had enough time to master the engineering requirements of its nuclear program until it acceded to the NPT in 1985 as a NNWS, a condition imposed by the USSR: the Soviet would only supply the North Korean power station if the country agreed to abide by the rules of the non-proliferation regime[85]. According to article III states party to the NPT are compelled to accept safeguards in an agreement with the IAEA, in order to verify its obligation under article II to refrain from manufacturing or acquiring atomic weapons[86]. In this sense, North Korea had to provide a description of its nuclear program, materials and facilities and also guarantee that inspectors would have access after the country ratified its safeguards agreement with the IAEA in 1992. Currently it is widely recognized that the safeguards were violated between 1992 and 2002, when the IAEA inspectors were expelled from the country after requesting further access to North Korean nuclear facilities.

North Korea acceded to the NPT in 1985 but only concluded its Safeguard Agreement with the IAEA in 1992. It is believed that between 1989 and 1991 the country extracted up to ten kilograms of plutonium from its research reactor at Yongbyon through reprocessing of the spent fuel rods [87]. Jeffrey Goldstein holds that by that time North Korean officials quickly learned how to use the nuclear program to gain leverage and, in

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84 Mary Beth Nikitin, "North Korea`s Nuclear Weapons: Technical Issues," Congressional Research Service, February, 2013, p.3.

85 "Nuclear Proliferation Case Studies, North Korea," World Nuclear Association, last update May 2013. http://www.world-nuclear.org/info/Safety-and-Security/Non-Proliferation/Appendices/Nuclear-Proliferation-Case-Studies/#.UgmISBY75c0

86 Frederic L. Kirgis, "North Korea`s Withdrawal from the Nonproliferation Treaty," American Society of International Law, 2003. Accessed August 15, 2013. http://www.asil.org/insigh96.cfm

87 Mun Suk Ahn, "What is the Root Cause of the North Korean Nuclear Program*?,"* Asian Affairs, An American Review, 2011), p.178.

1993 the country threatened the Clinton administration by withdrawing from the NPT and forcing the North-Korea-U.S. high-level talks[88]. In the agreed framework that resulted from the bilateral negotiations, North Korea was convinced to stop its nuclear program for about US$ 5 billion in energy-related assistance and the lifting of economic sanctions[89]. In 2006, North-Korean officials gained some leverage in the Six-Party Talks after conducting their first nuclear test. Goldstein also affirms that the second nuclear test in 2009 North Korea`s intent was to force the U.S. to give up the denuclearization of the country and to accept its status as real nuclear power. Finally the country carried out a third nuclear underground explosion in 2013, probably to test a smaller and lighter warhead [90].

Besides cheating under the non-proliferation regime and using its status as VNP to gain leverage in the negotiation table, North Korea`s withdrawal from the NPT helped undermine the credibility of the treaty. After expelling the IAEA inspectors, in 2003 North Korea made use of Article X of the NPT alleging that the American policy was threatening its existence, jeopardizing its supreme interests[91]. North Korean allegations that it would suffer a pre-emptive nuclear attack from the U.S. were actually an attempt to divert attention away from their real objectives: resume missile testing, begin to

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[88]Pierre Goldschmidt, "Safeguards Noncompliance: A Challenge for the IAEA and the UN Security Council," Arms Control Association, 2010, Accessed August 16, 2013. http://www.armscontrol.org/act/2010_01-02/Goldschmidt

[89] "Nuclear Proliferation Case Studies, North Korea," World Nuclear Association, last update May 2013. http://www.world-nuclear.org/info/Safety-and-Security/Non-Proliferation/Appendices/Nuclear-Proliferation-Case-Studies/#.UgmISBY75c0

[90] Mary Beth Nikitin "North Korea`s Nuclear Weapons: Technical Issues," Congressional Research Service, February, 2013), p.14.

[91]Article X: Each party shall in exercising its national sovereignty have the right to withdraw from the Treaty if it decides that extraordinary events, related to the subject matter of this Treaty, have jeopardized the supreme interests of its country. It shall give notice of such withdrawal to all other Parties to the Treaty and to the United Nations Security Council three months in advance. Such notice shall include a statement of the extraordinary events it regards as having jeopardized its supreme interests.

reprocess spent fuel rods and reactivate its nuclear facilities. The withdrawal from the NPT finally let North Korea free from the Safeguards Agreement with the IAEA and the country could finally carry on its military nuclear program: article 26 of the agreement declares that it would remain in force as long as the democratic People`s Republic of Korea is party to the non-proliferation regime[92].

There is a general sense of impunity surrounding the North Korean case and a fear that other VNPs will follow suit. Pierre Goldschmidt captured the essence of the problem when he declared that "the great benefit that the NPT brings to the international community would be dangerously eroded if countries violating their safeguards agreements or the NPT felt free to withdraw from the treaty, develop nuclear weapons, and enjoy the fruits of their violation with impunity."

Conclusion:

This paper looked into how the emergence of VNPs affects the non-proliferation regime. After realizing that the spread of nuclear technology is a trend and that VNPs are the consequence of that trend, it was necessary to discuss the grand bargain and the three pillars of the NPT. Using the study of Matthew Fuhrmann to underpin the argument that nuclear cooperation leads to proliferation, it is possible to see that "technology-based arguments are probabilistic, not deterministic"[93] and that his conclusions point to a trend. It is easy to rule out his observations by saying that most countries do not go nuclear, but

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[92] Frederic L. Kirgis, "North Korea`s Withdrawal from the Nonproliferation Treaty," American Society of International Law, 2003. Accessed August 15, 2013. http://www.asil.org/insigh96.cfm

[93] Matthew Furhmann, "Spreading Temptation: Proliferation and the Peaceful Nuclear Cooperation Agreements," International Security, 2009, p.11.

it is not so easy to ignore that the spread of nuclear technology resulted in the emergence of VNPs and is therefore a source of distrust for the members of the NPT. A few NNWS such as Germany and Japan may never build nuclear bombs, but it takes only one case – North Korea – to put the whole non-proliferation regime under strain.

As it was mentioned, the reaction to the new threats is always to demand that NNWS give up their inalienable right, as ambiguous as it is, to develop peaceful nuclear programs. At the same time it is not possible to say that NWS are fully committed to the nuclear disarmament, which only stresses the inequality of the regime and the feeling of insecurity since it is part of the original bargain to "preclude the vast majority of signatories from the possibility of acquiring the most powerful weapons and thus limits their capability of achieving national security by military means[94]". In this sense NNWS may feel that they accepted a position of vulnerability without receiving anything in exchange.

Many analysts argue that nuclear weapons are not as necessary as they used to be a few years ago, because the new wars that result from ethnic disputes are characterized as internal conflicts and atomic weapons are effective for interstate conflicts. However, the international realm is very dynamic and interstate conflicts may happen again, especially if Iran decides to go nuclear. Ed Husain, for example, is already talking about a Cold War in the Middle East between Iran and Saudi Arabia, a traditional case of latent interstate conflict worsened by the millenary Sunni-Shiite power struggle [95]. A nuclear Iran would probably change the whole dynamics of the Middle East, and Saudi Arabia,

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[94] Jan Ruzicka and Nicholas J Wheeler, "The Puzzle of Trusting Relationships in the Nuclear Non-Proliferation Treaty," International Affairs. 2010, p. 70.

[95] Ed Husain, "Iran Versus Saudi Arabia: Cold War in the Middle East," Council on Foreign Relations, 2012, accessed Februray 23, 2013, http://blogs.cfr.org/husain/2012/04/20/iran-versus-saudi-arabia-cold-war-in-the-middle-east/

Turkey and Egypt would follow suit, establishing a multipolar nuclear arena in the most volatile region of the world[96].

The three examples aforementioned also demonstrated how the nuclear non-proliferation regime was not enough to curb the nuclear programs in Iraq, North Korea and Iran, let alone the Syrian reactor that was bombed by Israeli jets. If Iran is still a riddle, and Iraq is finally under control after a long war, North Korea is the bad example that clearly undermined the credibility of the non-proliferation regime, but that can also be useful in the future because it points out the loopholes that allow VNPs to go nuclear. The NPT cannot be effective only for those who are willing to cooperate. The nuclear non-proliferation regime will only be effective if states believe that noncompliance will be punished.

At the same time, establishing MNAs resting on voluntary participation might be a promising way to restore the credibility of the NPT, since the present legal framework does not oblige countries to participate in these arrangements. It is important to bear in mind, however, that countries would only enter into MNA according to economic and political incentives offered by these arrangements. From an economic perspective, it is undeniable that buying small quantities of uranium is cheaper than investing in indigenous enrichment facilities but NNWS do not trust NWS enough to give up the right to develop their own nuclear facilities.

Hence, in addition to the economic incentive it is necessary to develop an environment of mutual trust and consensus among all states party to the NPT, which should be based on full compliance with the agreed nuclear non-proliferation obligations.

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[96] Ari Shavit, "The Bomb and the Bomber," The New York Times, 2012, accessed 06 March 2013, http://www.nytimes.com/2012/03/22/opinion/the-bomb-and-the-bomber.html?_r=0

As proposed by the expert group report to the Director General of the IAEA, "in a voluntary arrangement covering assurances of supply, recipient countries would at least for the duration of the respective supply contract, renounce the construction and operation of sensitive fuel cycle facilities and accept safeguards of the highest current standards including comprehensive safeguards and the Additional Protocol." NWS would also have to do their part and fully commit to disarmament [97].

[97] Expert Group Report to the Director General of the International Atomic Energy Agency, "Multilateral Approaches to the Nuclear Fuel Cycle," IAEA, Vienna, 2005.

Chapter Two

Brazil`s Quest for Nuclear Independence: The Nuclear-Powered Submarine Program and the Nonproliferation Regime

Introduction:

Currently, all the permanent members of the United Nations Security Council, which are also Nuclear Weapon States under the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), have nuclear-powered submarines. Outside the club only India has one nuclear submarine and Brazil, as a non-nuclear weapon state under the NPT, is investing in its own program in cooperation with France. According to Eric Arnett, some observers have speculated that the purpose of the Indian nuclear submarine program was " intended to provide an invulnerable launching platform for nuclear weapons[98]." The Brazilian program is also raising concern among analysts. In this sense, this paper will investigate whether the Brazilian nuclear-powered submarine program poses a growing risk to achieving the nonproliferation goals of the treaty due to the dual-use technology dilemma: the same technology that makes fuel for nuclear reactors can also produce explosive material for nuclear bombs.

In the first part of the paper I will discuss the reason why the NPT does not establish safeguards for material used in NPRs in order to understand the perils behind the Brazilian nuclear powered-submarine program. Many policymakers and analysts believe that the NPT has been preventing the spread of nuclear weapons across the globe in the past decades. From another perspective, however, it is possible to affirm that the treaty helped stabilize the arms race in a bipolar world even though it was not prepared

[98]Mark Gorwitz, "The Indian SSN Project: An Open Literature Analysis," FAS: December 1996.

for the challenges posed by the spread of dual-use technology in a multipolar world. Goods and technologies are considered dual-use when they can be used both for civil and military purposes. In this regard, the right to pursue a peaceful nuclear program led to the expansion of nuclear power plants worldwide and investment in indigenous fuel-cycles, which was an important part of the agreement between nonnuclear weapon states (NNWS) and nuclear weapon states (NWS). Currently, there are approximately 1,440 tons of highly enriched uranium (HEU) in the world that can be used to build nuclear weapons[99].

In the second part, I will analyze the technology involved in the nuclear marine propulsion, a device in which chain reactions are initiated, controlled and sustained at a steady rate[100]. Since only 0,7% of the uranium found in nature is U 235, it is necessary to enrich the uranium fuel to operate the reactor. Thus, the development of a naval nuclear reactor may lead to the mastery of a complete nuclear fuel cycle. Besides the spread of nuclear technology there is also another problem: plutonium is the byproduct of uranium enrichment. Just like HEU, plutonium could also be stolen by terrorists seeking to build nuclear weapons. Moreover, the NPT might be successful against the spread of nuclear weapons but it does not explicitly regulates the production, use and disposal of HEU for naval nuclear reactors. Greg Thielmann, for instance, highlights the fact that nuclear submarine programs creates a military requirement for producing and stockpiling uranium enriched to a higher level than needed in civilian power reactors. Therefore, the Brazilian precedent would make it easier for other states that may have nuclear weapons

99 Corey Hinderstein, and Andrew Newman, and Ole Reistad, "From HEU Minimization to Elimination: Time to Change the Vocabulary," Bulletin of the Atomic Scientists, 2012.
100 Gheorghe Constantin, "Nuclear Marine Propulsion," Constanta Maritime University, Romania, 2009.

ambitions to use the NPT exclusion for nuclear submarine reactor fuel as cover for the pursuit of nuclear weapons[101].

In the third part of the paper I will investigate the reasons why a peaceful country such as Brazil is investing US$ 5 billion in the development of a nuclear-powered submarine program. After the former Brazilian Ambassador to the United States, Roberto Abdenur, said that " submarines are not subject to the safeguards regimen[102]" there is a growing debate on the primary purposes of the Brazilian Navy. According to Science magazine, for example, a uranium enrichment facility would give Brazil the breakout capability to produce enough fissionable material for six nuclear warheads a year[103]. It is important to stress that much of the speculation around the program does not take into account the constitutional prohibition of the construction of nuclear weapons in Brazil and also agreements such as the Treaty for the Prohibition of Nuclear Weapons in Latin America and the Caribbean (Treaty of Tlatelolco) and the agreement between Argentina, Brazil, the Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials and the International Atomic Energy Agency for the application of safeguards. Not to mention, of course, the fact that Brazil has been an active member of the NPT since 1998.

The fact that the Brazilian establishment believes that the United Nations role in global governance still reflects the immediate post-WWII era helps clarify many political decisions related to the Brazilian nuclear-powered submarine program. As pointed out by the former Brazilian Foreign Minister Celso Amorim, emerging countries are still

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101 Greg Thielmann, and Serena Kelleler-Vergatini, "The Naval Nuclear Reactor Threat to the NPT," The Arms Control Association, July 24, 2013.
102 James Clay Moltz, "Submarine and Autonomous Vessel Proliferation: Implications for Future Strategic Stability at Sea," US Naval Postgraduate School, 2012.

103 Larry Rohter, "Nuclear Secrets: If Brazil Wants to Scare the World, It`s Succeeding," The New York Times, October 31, 2004.

struggling to find a place under the sun. Until recently, almost all global decisions related to peace and security were made by the permanent members of the Security Council: United States, United Kingdom, Russia, China and France[104]. Thus, it is widely perceived that NNWs have more obligations under the NPT than NWS, which are not fully committed to disarmament.

Currently, however, it is hard to discuss multilateral issues of war, peace and commerce without taking into consideration the position of countries such as Brazil, India, Turkey and a few other global players that are also shaping international relations. Emerging countries have their needs and are already feeling the costs of progress. Decades ago, Brazil experienced problems trying to import nuclear fuel and nuclear technology. Therefore, Brazil`s nuclear policy is based on self-sufficiency, technological progress and independence and that explains the persistence of the country in developing a nuclear fuel cycle, building nuclear power plants and nuclear powered submarines[105]. As of 2007, 31 countries were using about 440 commercial nuclear reactors to generate about 16 percent of the world`s electricity[106]. Unfortunately, the same technology that provides comfort and quality of life can also cause death and destruction.

Literature review:

In 2013 President Dilma Rousseff said that Brazil is set to join the select group of countries that have nuclear-powered submarines, such as the United States, Russia,

104 Celso Amorim, " Let`s Hear From the New Kids on the Block," The New York Times, June 14, 2010.
105 Togzhan Kassenova, "Brazil`s Nuclear Kaleidoscope: An Evolving Identity," Carnegie Endowment for International Peace, 2014.
106Charles D Ferguson, "Proliferation Risks of Nuclear Power Programs," NTI, December 1, 2007.

France, Britain and China [107]. She was probably advised to avoid any mention of India, whose program began in the 1980s with a leased Soviet nuclear submarine and now is in the process of developing an indigenously built nuclear submarine capability. Unlike Brazil, India is not part of the NPT and will probably use its vessels as launching platforms for its nuclear weapons. The fact that Brazil will have access to sensitive nuclear technology and the HEU used in NPRs will be outside the IAEA safeguards agreement is again raising concerns related to the perils of latent proliferation. Will the mastery of the nuclear fuel cycle make it easy for Brazil to resume its nuclear weapons project?

The right to pursue and develop a peaceful nuclear program is an important part of the bargain between NNWS and NWS but the relation between nuclear cooperation and the spread of nuclear weapons has helped divide state members of the NPT into sharply opposing groups. World powers are currently imposing harsh conditions on the transfer of civilian nuclear technology and also prioritizing the nonproliferation pillar of the agreement [108]. At the same time, they are undermining the NPT pillar related to disarmament due to the modernization of nuclear stockpiles. Hans Kristensen affirms that " the United States has embarked on an overhaul of its entire nuclear weapons enterprise, including development of new weapons delivery systems and life extension programs

107 Agence France-Presse, " Brazil to Get Its First Nuclear Subs," Defense News, March 2, 2013. http://www.defensenews.com/article/20130302/DEFREG02/303020009/Brazil-Get-Its-First-Nuclear-Subs

108Daniel H Joyner, " Interpreting the Nuclear Non-Proliferation Treaty," Oxford University Press, 2011.

(LEPs) and modernization of all its enduring nuclear warhead types and nuclear weapons production facilities [109]."

The credibility of the NPT is clearly at stake. Since the beginning of the nonproliferation regime, many analysts have been worried about the perils of latent proliferation, since civilian nuclear programs could lead to the accumulation of plutonium as a by-product of reactors and can become explosive after the separation from spent fuel in reprocessing plants. Even though all the material that is supposed to be used in civilian nuclear programs is under safeguards there is always the latent risk that they could be diverted from nuclear power plants to be used in nuclear weapons. NPRs offer much higher risks because all the material destined to non-proscribed military activities are outside IAEA safeguards.

In addition to the perils of latent proliferation, global submarine proliferation is also a trend that is raising concern worldwide. Despite the fact that the number of submarines active in the oceans decreased after the end of the Cold War, submarine procurement has been increasing in the past decades and it is likely that a undersea arms race is gathering momentum. David Lague affirms, for example, that "many of the major submarine purchasers (including Pakistan, India, Israel and China) are in regions of concern and some possess weapons of mass destruction (WMD), which may be deployed on these new submarines, thanks to the relative ease of acquiring cruise missiles on the international market [110]." Another potential problem, according to James Clay Moltz, is that countries such as Brazil may be using nuclear submarine programs to develop a full

[109]Hans Kristensen. " Nuclear Weapons Modernization: a Threat to the NPT?" Arms Control Association, May 2014.
[110]David Lague, "We All Live for Another Submarine," Far Eastern Economic Review, August 15, 2002.

nuclear fuel cycle[111]. In addition, they would have access to HEU and possibly other NPT members would follow suit. There is always the possibility that potential virtual nuclear powers will try to divert HEU fuel to a bomb project because that is the dual nature of the nuclear technology.

In the global submarine proliferation market, France is recognized as a country that has often been providing technology transfer to purchasers who want to develop their own indigenous technology. France has provided Agosta-class diesel boats and production technology to Pakistan and in 2003 India`s Defence Ministry declared that it had strike a deal with France to produce six advanced Scorpene-class diesel submarines that will be built in India[112]. It is interesting to notice that Pakistan offered a second hand Agosta-class submarine to Saudi Arabia, showing that France`s export might be contributing to the development of secondary market with unforeseeable consequences. It is well reported that the Saudis have nuclear ambitions and that the Iranians own a fleet of Russian vessels[113]. In the agreement with Brazil, France will build four diesel submarines and provide assistance with the non-nuclear components of one nuclear submarine.

Greg Thielmann calls attention to the fact that the acquisition of fissile material is the biggest obstacle to building nuclear weapons and that is the reason why the prohibition of uranium enrichment above levels used in civilian power reactors would

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[111]James Clay Moltz, "Global Submarine Proliferation: Emerging Trends and Problems," NTI, April 2006.

[112] Navbharat Times, " Report: Way Cleared for French Submarine Scorpion to Be Manufactured in India," October 6, 2003.

[113]Usman Ansari, " Pak-Saudi Defense Cooperation to Expand, but Questions Arise," Defense News, January 27, 2014.
http://www.defensenews.com/article/20140127/DEFREG03/301270031/Pak-Saudi-Defense-Cooperation-Expand-Questions-Arise

work as an important barrier to proliferation. He also adds that the exclusion of HEU for NPRs from the IAEA safeguards confers legitimacy to the enrichment and stockpiling of HEU, which could be diverted for use in a nuclear weapons program. In this context, Brazil, as the first NPT NNWS with a nuclear-powered submarine, could set a dangerous precedent for states with nuclear ambitions, such as Iran. Senior Iranian naval officers have already declared that they are considering to build their own nuclear submarines using HEU up to 45-56%. Therefore, Thielmann affirms that the IAEA " should seek enhancements to safeguards agreements that tighten monitoring measures for uranium designated for naval nuclear reactors [114]."

Every discussion that involves the proliferation risks of nuclear power programs due to the dual-use of nuclear technology must take into consideration the article IV of the NPT, which declares that a state has the right to peaceful nuclear technologies as long as it maintains safeguards on its peaceful nuclear program and does not manufacture nuclear explosives. Charles D. Ferguson affirms that " this article does not specifically mention uranium enrichment and plutonium reprocessing technologies as part of a state`s right to peaceful nuclear technologies, it does not explicitly exclude enrichment and reprocessing technologies [115]." It is important to stress that has been considerable debate whether this right should be interpreted to include bomb usable technologies, even though the right has usually been interpreted to include these technologies.

In spite of the bilateral cooperation in the Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC), the dual nature of the Brazilian

[114]Greg Thielmann, and Serena Kelleler-Vergatini, " The Naval Nuclear Reactor Threat to the NPT," The Arms Control Association, July 24, 2013.

[115]Charles D Ferguson, "Proliferation Risks of Nuclear Power Programs," NTI, December 1, 2007.

nuclear program is already raising concern among some scholars in Argentina, even though there are no official declarations of the Argentinian government against Brazilian nuclear policies. According to Juan Gabriel Tokatlian, for example, " the episodic and public manifestations of voices in favor of nuclear weapons in Brazil generate genuine worries in Argentina, both in the government and among interested citizens [116]." Indeed in 2009 Vice President Jose Alencar said that nuclear weapons could provide Brazil with a deterrent and result in more respectability from the international community, especially after the discovery of huge oil reserves in the pre-salt layers.[117] Interesting to notice, however, that his words had more repercussion abroad than in Brazil, where his cause did not find many supporters. Argentina`s skepticism is also explained by the rivalry between the two countries when both were pursuing the construction of nuclear weapons decades ago. In 1974, Argentina put into operation the first nuclear power plant in Latin America.

Togzhan Kassenova interpreted the Brazilian nuclear-powered submarine in a different way. Aware that Brazil tried to build the bomb in the past, she understands that after signing the NPT in 1998 the focus shifted to the pursuit of the benefits of a peaceful nuclear program with indigenous technology. At the same time, she affirms that Brazilian diplomats usually take an aggressive stance in the defense of article IV of the NPT, because" like a majority of non-nuclear weapon states, Brazil views the nuclear order as an unfair arrangement based on an unfulfilled bargain of the Treaty on the Non-Proliferation of Nuclear Weapons between " haves" and " have nots", a promise of the

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[116]Juan Gabriel Tokatlian, "The State of Argentine-Brazilian Nuclear Relations," Columbia University Journal of International Affairs, April 26, 2013.
http://jia.sipa.columbia.edu/online-articles/state-of-argentine-brazilian-nuclear-relations/
[117]Tania Monteiro, "Alencar Defende que Brasil Tenha Armas Nucleares," *O Estado de Sao Paulo*, September 24, 2009.
http://politica.estadao.com.br/noticias/geral,alencar-defende-que-brasil-tenha-armas-nucleares,440550

five recognized nuclear weapon states to work toward disarmament and of all other signatories not to develop nuclear weapons [118]."

Currently, the proliferation of dual use technology is a direct consequence of article IV of the NPT. It is clear that every time that a NNWS acquire expertise in the mastery of the nuclear fuel cycle it will raise concern in the international community. At the same time, the implementation of the safeguards as established in article III depends on the NWS commitment to disarmament. The same logic applies to the NPRs: the United States continues to use weapons grade uranium in its submarines while its diplomacy points out to the fact that the spread of nuclear technology will increase the amount of HEU and plutonium in the world.

Methodology

In this regard, my research will look into the Brazilian nuclear-powered submarine program and how the lack of regulation concerning NPRs might work as a good excuse for a country that is willing to produce weapons grade uranium and resume its nuclear weapons program. Since it is an ongoing project, it will be necessary to analyze the history of the Brazilian nuclear program, official speeches, documents and declarations in order to assess its real intentions. Moreover, in order to confirm the hypothesis, it will be necessary to look for any indication in previous researches that Brazilian enrichment facilities tried to produce or accumulate HEU.

[118]Togzhan Kassenova, *"Brazil`s Nuclear Kaleidoscope: An Evolving Identity,"* Carnegie Endowment for International Peace, 2014.

The NPT and the Lack of Regulation Concerning Naval Propulsion Reactors (NPRs)

In the book *Uranium: War, Energy and the Rock that Shaped the World*, Tom Zoellner noted that the mineral encompasses the best and the worst in mankind: scientific progress and human annihilation are two sides of the same coin. Thus, once it is dug up, it can never be reburied again [119]. Actually, uranium became one of the defining aspects of world politics in the 21st century. The NPT somehow recognizes the duality of nuclear energy and proposes a grand bargain that rests in three pillars: nonproliferation, peaceful use of nuclear energy and disarmament. In order to strike the deal, however, the authors of the treaty had to leave a number of nuclear activities in the category of acceptable uses, such as peaceful nuclear explosions (PNEs) for industrial purposes and the operation of naval propulsion reactors (NPRs)[120].

Aware of the perils of the proliferation of nuclear technology, the NPT not only established that NNWS had the inalienable right to develop a peaceful nuclear program in article IV but also that they should accept that safeguards be applied to all nuclear material used for civilian purposes. According to article III: "each non-nuclear-weapon State Party to the Treaty undertakes to accept safeguards, as set forth in an agreement to be negotiated and concluded with the International Atomic Energy Agency in accordance with the Statute of the International Atomic Energy Agency and the Agency's safeguards system, for the exclusive purpose of verification of the fulfillment of its obligations assumed under this Treaty with a view to preventing diversion of nuclear energy from

[119]Tom Zoellner, "Uranium: War, Energy and the Rock that Shaped the World," Penguin Books, 2009.
[120]James Clay Moltz, " *Closing the NPT Loophole on Exports of Naval Propulsion Reactors,"* The Nonproliferation Review, Fall 1998, p. 108

peaceful uses to nuclear weapons or other nuclear explosive devices [121]." The NPT, however, does not regulates the production, use and disposition of HEU for naval nuclear reactors.

The lack of regulation in the NPT was purportedly to be commercial and allow countries under the treaty to reap the benefits of progress. PNEs, for example, had a variety of objectives such as deep seismic sounding; creating underground cavities; helping to extract gas and oil; extinguishing burning gas or oil wells; creating reservoirs and helping to construct a canal[122]. Despite of its peaceful intentions, the detonation of nuclear devices above ground was injecting large quantities of radioactive material into the atmosphere and contaminating the environment. According to Benjamin K. Sovacool, " a 104-kiloton detonation at Yucca Flat, Nevada, displaced 12 million tons of soil and resulted in a radioactive dust cloud that rose 12,000 feet and plumed toward the Mississippi River[123]." With regard to NPRs, Italy and Holland were interested in the use of nuclear propulsion in commercial vessels but only the Soviet Union really applied the technology to real civilian activities, creating the nuclear icebreakers that are still used in the Arctic[124]. Furthermore, other parties involved in the negotiation were interested in the advantages of nuclear submarines.

In 1996 the signing of the Comprehensive Test Ban Treaty (CTBT) finally prohibited the PNEs and closed one important loophole in the NPT. However, the story is

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[121] Department of State, "Treaty on the Non-Proliferation of Nuclear Weapons," US Delegation to the 2010 Nuclear Nonproliferation Treaty Review Conference, 2010.
[122] " Peaceful Nuclear Explosions," Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization.
http://www.ctbto.org/nuclear-testing/history-of-nuclear-testing/peaceful-nuclear-explosions/
[123]Benjamin K Sovacool. "Contesting the Future of Nuclear Power: A Critical Global Assessment of Atomic Energy," World Scientific, 2011, p.171–2.
[124]James Clay Moltz, "*Closing the NPT Loophole on Exports of Naval Propulsion Reactors,"* The Nonproliferation Review, Fall 1998, p. 109.

different concerning nuclear naval propulsion. The objections presented by both NWS and NNWS left NPRs outside of the treaty, which meant that nuclear materials in propulsion were not subject to safeguards. According to the IAEA`s former Assistant Director General for External Relations David Fischer " it was generally widely recognized that this was a serious loophole in the safeguards prescribed by the treaty[125]."

James Clay Moltz stresses that states parties were also fully aware of the dangers implied in the lack of regulation because it was likely that other states could block inspections by saying that their fissile material was going to be used as fuel for NPRs. In this regard, they tried to bring NPRs under safeguards but the result was not satisfying: before withdrawing nuclear material from safeguards for non-explosive military use, states would have to comply with a series of requirements that prevented its use for a nuclear weapon but did not forbid its use for nuclear propulsion. Moltz also affirms that " they (member states) did nothing to remedy the absence in the NPT of any restrictions on the transfer of nuclear materials and technology for use in a propulsion reactor."

According to Greg Thielmann "under the terms of the NPT, enriched uranium that is burned in naval propulsion reactors is not subject to safeguards in either NWS or NNWS[126]." It is always important to highlight the fact that NWS signed reduced versions of safeguards agreement as an incentive to non-proliferation, since they were not required to do that. As it was established by article III, however, most NNWS negotiated and ratified comprehensive safeguards agreement with the IAEA that are applied to all nuclear material used for civilian purposes. Thus, basically 100% of their material is

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[125] Ibid.

[126]Greg Thielmann, and Serena Kelleler-Vergatini, " The Naval Nuclear Reactor Threat to the NPT," The Arms Control Association, July 24, 2013, p.02.

under safeguard, because they are not allowed to have nuclear weapons programs. Thielmann also stresses that the NPT regulate the use of nuclear material for naval propulsion only minimally.

According to IAEA INFCIRC/153, which establishes the model safeguards agreement for the NPT, the nuclear material of state parties is not subject to safeguards as long as it is destined for non-proscribed military activities. For nuclear propulsion, however, states should comply with three requirements. First of all, IAEA should be informed about the activity and during the period of non-application of safeguards the nuclear material will not be used for the production of nuclear weapons; Second, the agency and the state should reach an agreement that the material will not be under safeguards only while it is being used for such activity. As soon as the material is reintroduced into peaceful nuclear activity, safeguards will be reapplied. Finally, INFCIRC/153 also states that each arrangement shall be made in agreement with IAEA and that such agreements " shall only relate to the temporal and procedural provisions, reporting arrangements, etc., but shall not involve any approval or classified knowledge of the military activity or relate to the use of the nuclear material therein [127]." Greg Thielmann concludes that the minimal legal framework and lack of additional transparency measures would hinder any possibility of the IAEA to find out that fissile material designated for NPRs are being used in nuclear weapons program[128].

In conclusion, the NPT is permissive enough with countries enriching uranium for NPRs or non-proscribed military activities. In this sense, it is likely that NNWS such as

[127] INFCIRC /153, paragraph 14.
[128]Greg Thielmann, and Serena Kelleler-Vergatini, " The Naval Nuclear Reactor Threat to the NPT," The Arms Control Association, July 24, 2013, p.04.

Brazil will accumulate HEU. At the same time it is important to highlight the fact that in 1991 Brazil and Argentina signed the Guadalajara agreement, which established that the two countries were only allowed to develop civilian nuclear programs. It also created the Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC) to oversee the application and management of the Common System for Accounting and Control of Nuclear Materials. Despite the fact that the Quadripartite Agreement (Brazil, Argentina, ABACC and the IAEA) allows its signatories to withdraw nuclear material for propulsion purposes, Brazil`s safeguards agreement is more restrictive than the model used for NNWS[129]. On the one hand article 1 of Brazil`s agreement applies safeguards to all nuclear material in all nuclear activities [130]. On the other, INFCIRC/153 refers to safeguards that should apply in all peaceful activities[131].

Naval Propulsion Reactors and the Full Nuclear Fuel Cycle

The world has been facing the perils of dual-use technology since 1954, when Obninsk, the first non-military nuclear power station, was commissioned in Russia. Just like commercial nuclear reactors, most NPRs run on uranium-235, because uranium-238, the most abundant isotope, does not sustain nuclear chain reactions[132]. Since only 0,7% of natural uranium is uranium-235, fuel enrichment is a fundamental part of the process: most commercial nuclear reactors are fueled with LEU (3,5%) while NPRs can also run

[129] Ibid., p.07.

[130] INFCIRC/435, article 1.
[131] INFCIRC /153, paragraph 1.
[132] Charles D Ferguson, "Risks of Civilian Plutonium Programs," NTI, July 1, 2004.

run with LEU, HEU and also weapons grade uranium. It is widely recognized that U.S. and U.K. are highly dependent on weapons grade uranium for their NPRs.

Uranium and plutonium can be used as fuel for nuclear reactors, since both of them release large amounts of nuclear energy, which is converted into electricity. Plutonium, however, decay much more rapidly than uranium isotopes: while the former only exist in trace quantities in nature, the latter is much more abundant in the isotope uranium-238. Charles D. Fergusson explains that "nuclear reactors, however, make plutonium when uranium-238 absorbs neutrons and then undergoes a relatively rapid series of radioactive decays to become plutonium-239. Thus, the relatively vast amounts of uranium-238 available in mines located in many nations could, in principle, serve as fertile material to produce vast amounts of nuclear fuel[133]." While uranium-235 is called a fissile isotope because it easily fissions if it absorbs a neutron of almost any energy, uranium-238 is called a fissionable isotope because it has only a relatively small probability of fission if it absorbs high energy neutrons [134].

In naval nuclear propulsion, uranium fissions and produces heat to convert water into steam, which is used to turn turbines that power the onboard systems and drive the propeller [135]. The mineral is one of the few materials capable of producing heat in a self-sustained chain reaction. The reactor used in this process is the pressurized water reactor (PWR), which is surrounded by multiple layers of shielding materials to protect crew members from radiation. As a security measure, PWR designs do not contain enough

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[133] Ibid., p.02
[134] Charles D Ferguson, "Proliferation Risks of Nuclear Power Programs," NTI, December 1, 2007.
[135] Gheorghe Constantin, "Nuclear Marine Propulsion," Constanta Maritime University Romania, 2009, p.324.

fissile uranium to sustain a prompt critical chain reaction. According to Gheorghe Constantin, " when a neutron causes a Uranium atom to fission, the Uranium nucleus is split into parts producing atoms of lower atomic number called fission products. When formed, the fission products initially move apart at very high speeds, but they do not travel very far (…), before they are stopped within the fuel cladding. Most of the heat produced in the fission process comes from stopping these fission products within the fuel and converting their kinetic energy into heat [136] ."

Enrichment technologies are necessary to produce the ceramic pellets of uranium dioxide (UO2) that will compose the fuel rods that are used to build the core of the reactor. In the case of nuclear powered submarines, NPRs can run with different enrichment grades. Weapons-grade uranium is defined as a mixture of uranium isotopes consisting of more than 90 percent uranium-235, which is more suitable to weapons but it is used in American and British nuclear powered submarines as well. Highly enriched uranium is defined as consisting of a 20 percent or greater concentration of uranium-235 and can power explosive chain reactions. The low-enriched uranium, however, is suitable for reactors but not for powering bombs and is defined as consisting of greater than 0.72 percent but less than 20 percent uranium-235 [137].

Charles D. Ferguson also highlights the fact that LEU enrichment plant is a latent nuclear explosive material factory. The same enrichment technology can be used to make either LEU or HEU, since " a centrifuge enrichment plant could be designed to allow the operator to change the connections among the centrifuge units to shift cascades from

[136] Ibid.
[137] Charles D Ferguson, "Proliferation Risks of Nuclear Power Programs," NTI, December 1, 2007, p.3.

LEU to HEU production [138]." In this regard, it is more complicated for inspectors to determine whether an enrichment plant is complying with the requirements of the IAEA. Another challenge is that operators could use the LEU product from one pass through the plant for another pass through the plant until it reaches the desired concentration of uranium-235. Charles D. Ferguson explains that " only a handful of passes typically four or five, are needed to boost LEU to weapon-grade level[139]."

Despite the fact that Air Independent Propulsion (AIP) technology has provided diesel submarines with the capacity to stay submerged for several weeks instead of several days, many countries continue to pursue nuclear propulsion, probably because in addition to the advantages of the vessel countries could also invest in the mastery of the nuclear fuel cycle. It is estimated, for example, that Brazil will save around US$ 10-12 million annually by producing its own fuel[140]. Furthermore, as it was aforementioned, the NPT permits NNWS to acquire naval propulsion reactors, whose nuclear fuel is enriched to a higher percentage and is free from safeguards (non-proscribed military activities). It can really be used as an excuse for countries that are willing to secretly develop nuclear military capacities. Therefore, nuclear-powered submarine programs pose a real challenge to IAEA`s inspection authority.

The Brazilian Nuclear-Powered Submarine Program

[138] Charles D Ferguson, "Proliferation Risks of Nuclear Power Programs," NTI, December 1, 2007, p.3.
[139] Ibid., p.4
[140] Erico Guizzo, "How Brazil Spun the Atom (Nuclear Power Reactors)," Spectrum, IEEE: March 2006.

Brazil`s involvement with nuclear technology began a long time ago, during the Manhattan Project, when the country supplied the United States with uranium ore. Uranium is found all over the world but only a few countries have it in enough quantities to commercially explore it. Brazil, for example, has five percent of the uranium in the world [141]. The country continued to provide raw material until the 1950s, when the Brazilian government developed the policy of " specific compensation", which established that each export of strategic minerals should correspond to a transfer of technology. After many setbacks throughout last decades, Brazil currently mines and mills uranium, produces nuclear fuel, operates two nuclear power plants and is building a third and last, but not least, finally inaugurated in 2011 the shipyard for constructing nuclear submarines using indigenously developed Brazilian technology.

In order to understand the reasons behind the nuclear-powered submarine program it is necessary to bear in mind that " the quest to develop an indigenously and fully independent nuclear program has long been an ambition of Brazilian political, scientific, economic and military officials[142]." Despite the cooperation with the U.S. in the context of Atoms for Peace program, which resulted in the first research reactor in 1957, the Brazilian government always faced United States reluctance concerning the transfer of dual-use technology and the supply of new nuclear plants. Therefore, Brazil signed an ambitious technology transfer agreement with Germany during the military regime: " on 27 June 1975 the Bonn government made a commitment to transfer at least

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[141] World Nuclear Association, "Uranium Mining 2011," www.world-nuclear.org, accessed July 16,2014. http://www.world-nuclear.org/info/Nuclear-Fuel-Cycle/Mining-of-Uranium/World-Uranium-Mining-Production/

[142] Carlo Patti, " Origins and Evolution of the Brazilian Nuclear Program (1947-2011)," Wilson Center, November, 2012. http://www.wilsoncenter.org/publication/origins-and-evolution-the-brazilian-nuclear-program-1947-2011

eight reactors and the full nuclear fuel cycle to Brazil under the international safeguards of the International Atomic Energy Agency (IAEA)[143]."

It is widely believed that due to American pressure, Germany refused to transfer the more reliable ultracentrifuge enrichment method and components essential for mastering the nuclear fuel cycle. The frustration with the Germans resulted in the creation of a secret military program, which was implemented by the three branches of the Armed Forces, in the middle of the military dictatorship in Brazil. Carlo Patti affirms that the program initially was focused on the production of uranium hexafluoride, but rapidly evolved to include " research into all phases of energy production and the construction of a miniature reactor for naval propulsion, and the development of nuclear explosives[144]." In the 1980s, Brazil had indigenously mastered the technology to convert yellow cake into pure uranium hexafluoride (UF6) and enrich uranium through the development of the ultracentrifuge method by the Brazilian Navy. After twenty one years of military dictatorship (1964-1985), the first civilian Brazilian President, Jose Sarney, announced that Brazil had reached the capacity of autonomously enriching uranium through a nuclear program that had been kept secret for national security reasons [145].

In 1988, the Brazilian Congress approved a new constitution that prohibited all nuclear activities except for peaceful purposes[146]. A few years later, in 1990 the first president democratically elected by the people after the end of the military dictatorship, Fernando Collor de Mello, shut down the Brazilian nuclear military program. During his

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[143] Carlo Patti, " Origins and Evolution of the Brazilian Nuclear Program (1947-2011)," Wilson Center, November, 2012.
http://www.wilsoncenter.org/publication/origins-and-evolution-the-brazilian-nuclear-program-1947-2011.
[144] Ibid.
[145] Arquivo Revista Veja, "Sarney Arma seu Ciclo," Veja Online, September 11, 1987.
http://veja.abril.com.br/arquivo_veja/capa_09091987.shtml
[146] Daphne Morrison, " Brazil`s Nuclear Ambitions: Past and Present," NTI, September 2006.

tenure, Brazil also signed a bilateral agreement with Argentina pledging to use nuclear technology only in civilian programs, which was enforced by the Common System of Accounting and Control of Nuclear Materials (SCCC)[147]. The Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC) was also created in this very same day. Therefore, President Collor de Mello opened the path to the Brazilian adherence to the nonproliferation regime, which would only be completed in 1998, during the Presidency of Fernando Henrique Cardoso, when the country finally ratified the NPT and became a NNWS. The 1990s were marked by an economic slowdown that resulted in the closure of the UF6 conversion plant and the suspension of the construction of two nuclear power plants: Angra I was commissioned in 1985, Angra II in 2002 and the third plant is still under construction.

The Brazilian nuclear program was only revived after the election of President Lula da Silva in 2003, mainly because of his personal commitment to the cause and Brazil`s strong economic growth during most of his administration. In 2007, he established a Ministerial Committee chaired by the Defense Minister Nelson Jobim to devise the National Defense Strategy. In 2008 the document was released with the following overarching goals: reorganization of the armed forces; restructuring of the Brazilian defense industry while promoting economic development; revising of the policies governing the composition of the armed forces[148]. The National Defense Strategy also emphasized the two priorities of the Brazilian Navy: the protection of oil platforms and the oil producing zones; the defense of waters under Brazilian jurisdiction, especially islands, the coastline, rivers and the delta of the Amazon river.

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[147] Ibid.
[148] Brazilian Ministry of Defense, " Estratégia Nacional de Defesa," December 17th , 2008. Accessed July 19, 2014.

The document also intertwined the role of the Navy with the necessity to invest in nuclear capability, when it called for Brazil to undertake the following initiatives: 1. To further the nuclear powered submarine program, conclude the complete nationalization and development of the fuel cycle (including gasification and enrichment) on an industrial scale; 2. Ensure that the country has technology for building reactors for its exclusive use; 3. Speed up the mapping, prospecting, and utilization of uranium deposits; 4. Develop the potential for designing and building nuclear thermoelectric power plants to be under national control, even if developed through partnerships with foreign states and companies; 5. Increase the capacity to use nuclear energy within a broad spectrum of activities [149]. It is also important to stress that the important role played by the navy in the nuclear program and in the National Defense Strategy stems from its communication strategy, which coined the term Blue Amazon in 2004, connecting Amazon forests and Brazil`s sea riches. In 2010, the term, which was well accepted by the public, was registered as a trademark [150]. The National Defense Strategy makes indirect reference to the Blue Amazon when it affirms that one of the priorities of the Navy is to protect the territorial waters under Brazilian jurisdiction.

The agreement with France came a few months after the release of the National Defense Strategy by the end of 2008, when the two countries finally signed a cooperation agreement to develop four conventional and one nuclear-powered submarine. France would only provide assistance with developing the non-nuclear components of the nuclear-powered submarine, while the NPR was supposed to be built by Brazilian naval

[149] Ibid.
[150] Marianne L Wiesebron, "Amazônia Azul: Pensando a Defesa do Território Marítimo Brasileiro," Revista Brasileira de Estratégia e Relações Internacionais, 2013, p 117.

engineers. The agreement also contemplated the construction of a submarine base and a shipyard in Rio de Janeiro that would be managed by the French private sector, and then returned to the Brazilian government in 20 years. In a press conference after the meeting with the Brazilian President Lula da Silva, the French President Nicolas Sarkozy declared that the strategic partnership would also include official support to the Brazilian aspiration of becoming a permanent member of the United Nations Security Council[151]. One of the most important objectives of the Brazilian diplomacy is to engage in the reform of the Security Council so it better represents the international reality of the 21st century.

The Brazilian submarine project is divided in three different phases[152]. The first one was focused on the production and shipment of yellow cake to Canada. In February 2012, however, the Brazilian Minister for Science and Technology Raul Raupp and the Navy Commander Admiral Julio Soares Moura Neto have inaugurated the Hexafluoride Production Unit (USEXA) that would produce 40 ton of UF6 a year. That was an important step to the Navy nuclear program and to the Brazilian nuclear power plants, such as Angra I and II [153]. The second phase is based on the construction of naval reactor that is already underway, since the Government approved funds in the order of U$ 525 million to support the project. The last and third phase is related to the construction of the submarine itself.

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[151] Permanent Mission of France to the United Nations in New York, " Security Council Reform,". Accessed October 20th, 2013, http://www.franceonu.org/france-at-the-united-nations/thematic-files/un-reform/security-council-reform/article/security-council-reform

[152] Paul D Taylor, "Why Does Brazil Need Nuclear Submarines*?,"* U.S. Naval Institute Proceedings, 2009, p 3.

[153] Defesanet, "*MB Inaugura a Unidade Piloto de Hexafluoreto de Urânio e o Centro de Instrução de Adestramento Nuclear Aramar,"* accessed October 20th, 2013, http://www.defesanet.com.br

The Brazilian Navy already enriches uranium up to 5% at Aramar Experimental Center in Ipero. Odair Goncalves, former chairman of Brazil`s National Nuclear Energy Commission (Comissao Nacional de Energia Nuclear, CNEN), said a few years ago that Brazil would probably power its submarines with fuel produced from uranium enriched to 18-19 percent [154].The French and the Chinese Navy are also using LEU in their nuclear submarines. According to specialists, "operations involving enriching uranium up to 20% could be authorized by the Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC) and the International Atomic Energy Agency (IAEA) under special safeguards arrangements[155]." Kassenova also points out to the fact that the Brazilian Navy currently leases uranium enrichment technology to a state-owned company overseeing the civilian fuel cycle (Brazilian Nuclear Industries) for use at the Nuclear Fuel Factory at Resende.

The Brazilian nuclear –powered submarine program seems to be part of a broader strategy that involves the military protection of the pre-salt layers, one of the biggest oil discoveries of the last decades, and also the Brazilian economy and infrastructure. Brazil currently does not have the capacity to produce enough enriched uranium to meet its needs, so it is obliged to import it from other countries. In this regard, the program would definitely lead to the development of a full nuclear fuel cycle.

Conclusion

[154] William Huntington, "*Brazilian Regulator Denies Uranium Claims,"* Arms Control Today, November 2005, p.37.
[155]Togzhan Kassenova, " Brazil`s Nuclear Kaleidoscope: An Evolving Identity," Carnegie Endowment for International Peace, 2014, p. 29.

There are no reasons to believe that Brazil is willing to resume its nuclear weapons program, even though there is no credible way to assess whether the country is accumulating HEU at the moment. However, the Brazilian nuclear-powered submarine program has potential to pose a threat to the nonproliferation goals of the NPT because the spread of nuclear fuel enrichment techniques will result in more virtual nuclear powers (VNP`s) across the globe, although that is the price to pay for the spread of dual-use technology. In addition, it will become harder for the IAEA inspectors to oversee uranium production and implement the safeguards when needed. Since Brazil will open the precedent it is likely that other countries will follow suit, which might also lead to the increase of enriched uranium and plutonium in the world.

The construction of a nuclear-powered submarine program and the nonproliferation regime are not at odds. It is not illegal to invest in non-proscribed military activities and it is not illegal to transfer NPR technology. It is undeniable that there are perils involved in the lack of safeguards for uranium fuel destined to those activities. In the case of Brazil, however, it is clear that the country has enough international credibility to carry on this kind of program. From a legal perspective, Brazil is a reliable state since it adhered to the nonproliferation regime back in the 1990s. Furthermore, the safeguards established by the quadripartite agreement are apparently more rigorous that those stated by INFCIRC/153[156], which are only related to peaceful activities. From a geopolitical point of view it is not likely that Brazil will resume a nuclear weapons program, which would destabilize the whole region. Even Argentina,

[156] INFCIRC/153, paragraph 14.

the neighbor that is a partner and a rival at the same time, agrees in principle that Brazil has the right to pursue an indigenous nuclear fuel cycle[157].

The international community was alarmed with the Brazilian nuclear-powered submarine because there are different explanations for the program and the Brazilian authorities are very secretive about its nature. Togzahn Kassenova affirms that the driving forces behind the program can be divided in into the following categories: strategic, bureaucratic and technological [158]. In a nutshell, the military expect to use the vessel to defend natural resources and the long Brazilian coastline and also for power projection in the South Atlantic. At the same time, the scientific community and the Navy expect to develop technology related to uranium enrichment and submarine building. From a diplomatic perspective, the program is a matter of prestige for a country that is a champion of disarmament and nonproliferation and is pursuing a permanent seat in the United Nations Security Council. Usually the rationale for the nuclear program can be found scattered over different declarations, official speeches and even newspaper articles.

NWS should never lose sight that NNWS also want to reap the benefits of peaceful nuclear cooperation, the original ideal of the nonproliferation regime that is embodied in article IV of the NPT. It is hard to convince a NNWS representative that nuclear energy and nuclear propulsion are dangerous toys, only fit for the developed countries that are part of the club. Impoverished countries such as Yemen are already considering the nuclear alternative as a matter of survival[159]. This is clear when you bear

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[157]Togzhan Kassenova, " Brazil`s Nuclear Kaleidoscope: An Evolving Identity," Carnegie Endowment for International Peace, 2014, p. 22.
[158] Ibid, p. 30.

[159]Tom Zoellner, " Uranium: War, Energy and the Rock that Shaped the World," Penguin Books, 2009, p. 249.

in mind that coal poisons the air, hydroelectric depends on the existence of rivers, natural gas is expensive and many countries cannot rely on oil. In the future, it is likely that scarce resources will lead poor states to invest more and more in civilian nuclear programs. The IAEA will naturally have to deal with the perils behind the proliferation of dual use technology and as pointed out by Daphne Morrison " states like Brazil which have mastered the fuel cycle are unlikely to give up their right to pursue enrichment technologies[160]." It was already demonstrated that indigenous nuclear fuel production would save the country millions of dollars a year.

Even if Brazil gives up its nuclear-powered submarine program, the precedent is already set and the impression that the current nonproliferation regime promotes technology denial is already embedded in the perception of developing countries negotiators, officials and dignitaries. In addition, nonproliferation demands placed on NNWS are tough while it is clear that progress towards nuclear disarmament is fragile. According to the Ministerial Declaration of the International Conference on Nuclear Security, in 2013, the U.S. and the United Kingdom " encourage states to further minimize the use of high enriched uranium on a voluntary basis and to use low enriched uranium where technically and economically feasible[161]." At the same time, it is well known that the U.S. and U.K are still using HEU and even weapons grade uranium for their NPRs.

International pressure concerning nuclear proliferation may work in specific situations, but it is not a panacea. Brazil ratified the NPT in 1998 and renewed its

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[160] Daphne Morrison, "Brazil`s Nuclear Ambitions, Past and Present," NTI, September 1, 2006.

[161] Ministerial Declaration, " International Conference on Nuclear Security: Enhancing Global Efforts," Vienna, Austria, July 2, 2013, paragraph 12.

international credentials as a peaceful and recently democratized country in search of development and stability. It is not likely, however, that the Brazilian nuclear program will be abandoned, even though there is no evidence that Brazil is willing to build atomic weapons. The country has too much to lose to resume a military nuclear program that would destabilize the only denuclearized region in the world. However, a copycat program is popping out in a sensitive region of the globe: the Middle East. For instance, Fereydoun Abbasi-Davani, head of Iran`s atomic Energy Organization affirmed that " for now we have no plans for enrichment above 20 percent. But in some cases… such as ships and submarines, if our researchers have a need for greater presence under the sea, we must build small engines whose construction requires fuel enriched to 45 to 56 percent[162]."

In order to guarantee a peaceful future for mankind it is not only necessary to regulate the material destined to non-proscribed military activities and enforce the safeguards but it is also mandatory that NWS give the example. Even though it is not possible to rebury uranium and pretend that the impoverished nations of the world cannot benefit from nuclear energy, it is possible to advocate the use of LEU in naval reactors. It is also possible and highly recommended that NWS speed up the pace of nuclear disarmament.

[162] Yeagneh Torbati. *" Iran May Need Highly Enriched Uranium in the Future, Official Says,"* Reuters, April 16, 2013. http://www.reuters.com/article/2013/04/16/us-iran-nuclear-idUSBRE93F12C20130416

Chapter Three

Illicit Nuclear Trade and the Nonproliferation Regime: The Challenge of Second-Tier Proliferant States

Introduction:

According to George Perkovich, "the difficulty of detecting weapons proliferation rises as the overall density of nuclear commerce, training and cooperation increases[163]." After all, nuclear know-how, equipment and fissile material have been spreading around the world as a direct consequence of Article IV of the Nuclear Nonproliferation Treaty (NPT), which acknowledges the inalienable right of sovereign states to develop and use nuclear energy for peaceful purposes. However, the same states that benefit from nuclear cooperation might also engage in nuclear proliferation networks in order to acquire equipment and tacit knowledge to build nuclear weapons.

In the fight against nuclear proliferation in the past few years, sanctions have become a very popular tool of coercive diplomacy, even if their effectiveness in changing the calculus of target states remains highly contested. As of November 2012, President Barack Obama declared that the U.S. had imposed the toughest sanctions in history and that they were having an impact on Iran`s economy[164]. For many different reasons, sanctions have been setting the tone of the bilateral relations between U.S. and Iran since 1979, when they were imposed for the first time in response to the hostage crisis.

Currently, sanctions are linked primarily to the concerns over the country`s nuclear acitivities. However, according to the final report of the Panel of Experts established pursuant to resolution 1929 (2010), issued on June 2012, sanctions are

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[163] George Perkovich, "Abolishing Nuclear Weapons: Why the United States Should Lead," Policy Brief No. 66, Carnegie Endowment for International Peace, October 2008, p.3.

[164] Bijan Khajehpour, Reza Marashi, and Trita Parsi, " Never Give In and Never Give Up: The Impact of Sanctions on Tehran`s Nuclear Calculations," National Iranian American Council, March 2013.

slowing the ability of Iran to expand some aspects of its fuel cycle activities. It continues, however, to seek items through illicit procurement to support its prohibited nuclear and ballistic missile programs. Apparently, sanctions are able to slow down nuclear programs but they do not prevent the engagement of nuclear proliferant states in illicit nuclear trade.

The spread of technological know-how and manufacturing capabilities in the past decades had a major impact on the nuclear weapons and missile programs of several developing countries, which are able to support one another directly at the state-to-state level or indirectly through private sector supplier networks. The development of these networks of second-tier proliferators will ultimately undermine the nonproliferation regime, as developing countries create indigenous nuclear weapons and delivery systems technologies, increasingly disconnecting from first-tier state or corprate suppliers, and trade among themselves for the capabilities that their individual programs lack[165].

In relation to Iran`s ongoing illicit nuclear and missile procurements, the Iranian President Hassan Rouhani recently declared that "of course we bypass sanctions. We are proud that we bypass sanctions because the sanctions are ilegal[166]." In addition, the head of the Iranian Atomic Energy Organization (AEOI), Ali Akbar Salehi, acknowledged that Iran has indeed purchased nuclear or nuclear-related components from other countries[167]. Interestingly, in August 2013 the AEOI held expositions on the nuclear program, which included a display specifically showcasing and complaining about goods used in its

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[165] Chaim Braun and Christopher F. Chyba, " Proliferation Rings: New Challenges to the Nuclear Nonproliferation Regime," International Security, Vol 29, No. 2 (Fall 2004), pp. 5-49.
[166] "Iran`s President Rouhani Hits Out at U.S. Sanctions, "BBC News, August 30, 2014. http://www.bbc.com/news/world-middle-east-28997452
[167] David Albright, Daniel Schnur, and Andrea Stricker, "Iran Admits Illegally Acquiring Goods for its Nuclear Programs," Institute for Science and International Security, September 10, 2014.

nuclear facilities that were allegedly sabotaged by Western governments and many of these goods were obtained illegally, according to specialists[168].

In the first part of the paper I will look into how illicit nuclear trade challenges the nonproliferation regime. Apparently, illicit nuclear trade has been a common response of states facing international efforts to block their access to acquire unconventional weapons and their means of delivery. The Iranian and North Korean nuclear and missile programs are based on military goods and sensitive technologies obtained from the international marketplace in breach of national export controls and sanctions. Daniel Salisbury highlights the fact that the history of international attempts to control sensitive technologies is cyclical: "shocks to the system, tightening of certain controls in response, and attempt by proliferating countries and entities working on their behalf to circumvent these controls[169]."

In order to assess the impacts of sanctions on illicit nuclear trade in North Korea and Iran, I rely on the following documents: UN North Korea Sanctions Panel Report, released on June 2013[170]; UN Iran Sanctions Panel Report, released on June 2014[171]. North Korea has set a dangerous example: it benefited from peaceful nuclear proliferation, became a virtual nuclear power (VNP), withdrew from the NPT and built nuclear weapons. Furthermore, North Korea has Always been deeply involved in illicit

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[168] Project Alpha, Sabotage? Iranian Exhibition Gives Insights into Illicit Procurement Methods and Challenges, September 4, 2014. Https://www.acsss.info/item/347-sabotage-iranian-exhibition-gives-insights-into-illicit-procurement-methods-and-challenges

[169] Daniel Salisbury, "How the Private Sector Can Do More to Prevent Illicit Trade," Arms Control Today, Vol. 43, No. 6, July/August 2013, p. 23.

[170] United Nations, "Report of the Panel of Experts Submitted Pursuant to Resolution 2094," (S/2013/337). http://www.un.org/sc/committees/1718/poereports.shtml

[171] United Nations, "*Report of the Panel of Experts established pursuant to resolution 1929 (2010)*," 11 June 2014, http://www.un.org/ga/search/view_doc.asp?symbol=S/2014/394

nuclear trade, which might confirm that the source of nuclear knowledge may have shifted from first-tier advanced industrialized states to second-tier developing industrial states, which are more likely to resort to proliferation networks in order to obtain wares for their nuclear weapons programs.

In the past decades, dense networks of second-tier proliferators such as Iran, North Korea and formerly Libya in connection with the A.Q. Khan network have been speeding up proliferation and lowering technological barriers[172]. As the primary recipients of nuclear technology of the Pakistani network, the three countries were considered by the U.S as rogue states committed with nuclear proliferation[173]. In this sense, it will be necessary to investigate how the Iranian nuclear program has been reacting to sanctions in the third part of the paper. If Iran`s pattern of behavior resembles the North Korean one, the country will probably take over the central role of spreading nuclear and missile technologies, especially because of its advanced nuclear missile and nuclear program.

Finally, analysts have pointed out that the future of illicit trade may include a pariah country, unauthorized entities in a country or even "rogue suppliers," criminal elements selling nuclear capabilities to other states[174]. As a rogue supplier, North Korea has demonstrated the capability and inclination to provide nuclear goods to customers, bypassing export controls and UN Sanctions[175]. In this sense, it is possible that Iran emerge as a rogue supplier as well, which will certainly complicate current nuclear talks.

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[172] Alexander H. Montgomery, "Ringing in Proliferation: How to Dismantle an Atomic Bomb Network," International Security, Fall 2005, Vol.30 Issue 2, p. 155.
[173] Ibid, p. 157.
[174] David Albright, Andrea Stricker, and Houston Wood, "Future World of Illicit Nuclear Trade: Mitigating the Threat," Institute for Science and International Security, July 29, 2013.
[175] Ibid.

Literature review

The discovery of A.Q Khan proliferation network brought into attention the role of illicit nuclear trade in the spread of nuclear, chemical , biological weapons and also their delivery systems[176]. Alexander H. Montgomery points out to the fact that "like the demand-side question of why states seek weapons, the supply-side question of where states try to get needed materials from is significantly affected by efforts of powerful actors to limit access to nuclear technologies[177]". In this sense, in order to assess how Iran and North Korea currently affect illicit nuclear trade, it is important to fully understand the structure of proliferation networks and the impact of sanctions in the nuclear calculus of both countries.

Since the creation of the United Nations, the Security Council has been resorting to sanctions as coercive enforcement tool in order to prevent the breach of international law, to maintain world peace and security and for implementation of its decisions. Especially after the end of the Cold War, "increased economic interdependence, the desire to avoid the costs of military action, and increased international collaboration through the United Nations have made sanctions a striking option for states wanting to coerce other states short of war[178]." According to the Security Council Sanctions Committee, the United Nations may impose comprehensive economic and trade sanctions

[176] Alexander H. Montgomery, "Proliferation Networks in Theory and Practice," strategic Insights, Volume V, Issue 6, July 2006.
[177] Ibid, p.1.
[178] Khalid Manzoor Butt, and Anam Abid Butt, "UN Santions Against Iraq: From Ailment to Chronic," Journal of Political Studies, Vol. 21, Issue -2, 2014, pp. 271-295.

and /or more targeted measures such as arms embargoes, travel bans, financial or diplomatic restrictions.

Once defined as economic weapons used to wage a nonmilitary campaign, extending the diplomatic process beyond verbal negotiations, scholars and policymakers have been discussing the effectiveness of sanctions in altering the policy direction of target states for a long time[179]. Since the 1960s and 1970s the debate has been oscillating between those who see sanctions as effective non-military instruments of coercion and those who claim that the effects of sanctions in policy direction are exaggerated[180]. Despite the fact that pessimists have formed the larger group, claiming that sanctions are not effective, there is a widespread belief that sanctions brought Iran to the negotiating table over its nuclear activities, even though its nuclear program remains active and the country is engaged in illicit nuclear trade.

The emergence of nuclear proliferation networks in the developing world is a new challenge that might undermine the effectiveness of sanctions and also the nonproliferation regime. The source of nuclear knowledge shifted from first-tier developed countries to second-tier developing countries that might be willing to support each others nuclear programs. In addition, developing countries have a poor record of implementing trade controls and sanctions and an increasing ability to manufacture reliable dual-use components. In this sense, sanctions were never adopted universally or applied effectively due to the inexistence of efficient export control regimes, which is an example of supply-side measures adopted by first-tier nuclear supplier countries.

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[179] Robert Eyler, "Economic Sanctions and International Policy and Political Economy at Work," Basingstoke and New York, Palgrave Macmillan, 2007.

[180] Matthew Moran, and Daniel Salisbury, "Sanctions and the Insurance Industry: Challenges, Risks and Opportunities," Business and Politics, Vol.16, No.2, 2014.

Therefore, proliferant states will continue seeking capabilities for their nuclear programs from an abundance of suppliers and intermediaries in the developing world[181].

Basically, there are two reasons that explain the emergence of nuclear proliferation networks: the will to build nuclear weapons and the impossibility of obtaining the required goods legitimately and/or legally[182]. If a strong demand from some states has always been the driving force behind proliferation, the structure designed to satisfy this demand is new. It is also important to stress that these networks benefit from the increase in worldwide trade flows in recent years coupled with the emergence of suppliers capable and willing to transfer sensitive technology to potential purchasers. The North Korean ballistic trade, for example, is usually believed to provide Pyongyang with between 500 million and one billion dollars annually[183].

Proliferation networks can have three diferent structures: rings, stars and cliques. As rings or circles, the connections between nodes form a circle. As a star, every node is connected through a central hub. The cliques are a much denser network in which each node is directly connected to every other node. In order to understand the strucutre of nuclear proliferation networks, it is important to bear in mind that nuclear weapons programs require tacit knowledge, which is a kind of knowledge that cannot be formulated in words or symbols, but must be learned through trial-and-error processes[184]. Tacit knowledge will make nuclear proliferation networks resemble stars, rather than

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181 David Albright, Andrea Stricker, and Houston Wood, "Future World of Illicit Nuclear Trade: Mitigating the Threat," Institute for Science and International Security, July 29, 2013.
182 Bruno Gruselle, " Proliferation Networks and Financing," Fondation pour la Recherche Strategique, Paris, march 3, 2007.
183 Ibid.p.8.
184 Ibid.

rings or cliques, while missile networks are more likely to become cliques much faster, because missile technology seems to be more transferable than nuclear technology.

In the first-tier missile proliferation network, Russia and China prevailed as the main hubs, sharing technology with four states: Iraq, Iran, North Korea and Syria. In relation to the second-tier ballistic missile proliferation network, it is interesting to notice that only the core second-tier proliferators are part of the group. Differently from first-tier transactions, however, the structure resembles more of a clique, instead of a star, due to the fact that relationships are more reciprocal. Three of the four core missile proliferators who received technology from both China and Russia later developed links between each other, such as Syria, Iran and North Korea. North Korea received early assistance from Egypt (1974-1981) and Iran (1988). Libya and Syria assisted Iran early in its program, which was subsequently reciprocated.

Existing ballistic missile and nuclear proliferation networks closely resemble stars and North Korea and Pakistan are the hubs or central nodes for each network[185]. The missile networks, however, resemble more of a clique than does the nuclear network but only Iran and North Korea form the hubs[186]. Since A.Q. Kahn enjoyed autonomy under the Pakistani government, it is also possible to affirm that Pakistan became the central hub of a nuclear proliferation network that transfered plans or parts to Iran, Lybia and North Korea and possibly offered assistance to countries such as Iraq and Syria. North Korea forms the center of a missile proliferation network and transfered technology to

[185] Alexander H. Montgomery, "Ringing in Proliferation: How to Dismantle an Atomic Bomb Network," International Security, Fall 2005, Vol.30 Issue 2, p. 153-187.
[186] Chaim Braun and Christopher F. Chyba, " Proliferation Rings: New Challenges to the Nuclear Nonproliferation Regime," International Security, Vol 29, No. 2 (Fall 2004), pp. 5-49.

Egypt, Iran, Iraq, Lybia, Pakistan, and Syria. Iran forms a smaller hub for missiles sales, which used to connect Libya, North Korea and Syria[187].

Finally, Alexander Montgomery affirms that if the North Korean and the Pakistani hubs are effectively shut down, the next step would be to turn nodes that could evolve into new hubs. In this sense, the advanced state of Iran`s missile and nuclear programs, as well as its participation in both networks, suggest that the country is the right candidate to take over the central role of spreading nuclear and missile technologies[188].

Illicit Nuclear Trade Networks Components and Methodology

Analysts affirm that states such as Iran, North Korea and Pakistan are currently involved with illicit procurement networks. The main objective of illicit nuclear trade is to procure nuclear direct-use and dual-use goods, many of which are controlled by national and international trade control regimes[189]. Illicit nuclear trade depends on network made up of an interacting collection of companies and individuals engaged in the process of procuring nuclear goods or capabilities. As aforementioned, a network is a collection of nodes that can represent a company, a person, or a state procurement organization. A node with many connections is considered to be a hub.

According to David Albright, networks of traffickers, suppliers and trading companies are connected by requests for price, quotes, orders, shipments, payments, and

[187] Alexander H. Montgomery, "Ringing in Proliferation: How to Dismantle an Atomic Bomb Network," International Security, Fall 2005, Vol.30 Issue 2, p. 153-187.
[188] Ibid, p. 185.
[189] David Albright, Andrea Stricker, and Houston Wood, "Future World of Illicit Nuclear Trade: Mitigating the Threat," Institute for Science and International Security, July 29, 2013.

other communications and transactions[190]. This paper also follows his definition of illicit nuclear trade, which is a trade that is not authorized by: "1) the state in which it originates; 2) under international law; 3) the states through which it transits; or 4) the state to which it is imported[191]."

Active smuggling networks are usually comprised of at least several of these major components[192]:

- A state nuclear program or complex which compiles lists of needed goods;
- A domestic nuclear procurement organization which receives the lists of needed equipment from the state nuclear program and organizes their procurement domestically and abroad;
- Often domestic front of trading companies working under contract for the nuclear procurement organization to obtain goods;
- Other front or trading companies or middlemen/brokers usually located abroad and further removed from the nuclear procurement organization, which are hired by the domestic front or trading company or the nuclear procurement organization for the purpose of placing orders for goods;
- Supppliers of goods;
- Intermediaries involved in shipping and logistics;
- Banks, financial institutions, or informal payment structures which wittingly or unwittingly facilitate financing for the goods.

[190] Ibid, p.9.
[191] Ibid. p.5.
[192] Ibid, p.10.

Countries that are deeply involved in illicit nuclear trade operate using some of these network components. The analysis of the UN North Korea Sanctions Panel Report and the UN Iran Sanctions Panel Report will show whether sanctions are preventing proliferant states from using them.

The Nonproliferation Regime and the Challenges of Illicit Nuclear Trade

According to Chaim Braun and Christopher Chyba, the nuclear programs of North Korea, Iran and Pakistan pose a real threat to the nonproliferation regime because they reinforce the risk of latent proliferation, in which countries adhere to the Nuclear Nonproliferation Treaty (NPT) but also try to develop nuclear weapons capability[193]. In the long run Iran can either continue as nonnuclear weapons state (NNWS) under the NPT or follow North Korea`s path and withdraw from the treaty.

Currently, second-tier nuclear proliferation also presents an unprecedented challenge to the nonproliferation regime because the spread of technological know-how and manufacturing capabilities is wider than hitherto believed and might engender more Virtual Nuclear Powers (VNPs). Second-tier proliferators might be defined as developing states - or private companies within those states - that may be supplying nuclear weapons-relevant material on the international market. In this sense, developing countries are trading nuclear technology, weapons designs and delivery systems among themselves to improve one another`s nuclear efforts. Therefore, technology transfer among proliferating states will cut the cost of and the period to acquisiton of nuclear weapons

[193] Chaim Braun and Christopher F. Chyba, " Proliferation Rings: New Challenges to the Nuclear Nonproliferation Regime," International Security, Vol 29, No. 2 (Fall 2004, pp. 5-49.

and missile capabilities, as well as reduce the reaction time of the overall nonproliferation regime[194].

Latent proliferation started decades ago as a colateral effect of the article IV of the NPT, which recognized the inalienable right of all the parties to develop research, production and use of nuclear energy for peaceful purposes. The result was the emergence of the so-called VNPs, which are able to develop nuclear weapons but stop before assembling them. Thus, initially nuclear weapons-relevant material spread from states or privates entities within states that are members of the formal nuclear exporters groups, the Nuclear Exporters Committee (or Zangger Committee) or the NSG[195].

The Khan network posed one of the most serious challenges to the nonproliferation regime since it was responsible for the most dangerous expansion of nuclear weapons technology over the past decades. Abdul Qadeer Khan, the father of the Pakistani nuclear bomb, and his associates were able to spread nuclear weapons technology for more than two decades by exploiting weaknesses in export control systems and recruting suppliers[196]. The Khan network started as an illicit procurement network aimed at supplying Pakistan`s gas centrifuge program and after a few years turned into a transnational illegal network that also exported gas centrifuges and production capabilities and designs for nuclear weapons to countries such as Iran, Iraq, Libya and North Korea. Khan has also offered aid to Egypt and Syria.

David Albright and Corey Hinderstein affirm that "the network adapted and benefited from the discriminatory and voluntary export control regime that was embodied

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194 Ibid.
195 Ibid, p.01.
196 David Albright and Corey Hinderstein, "Unravelling the A.Q. Khan and Future Proliferation Networks," The Washington Quarterly 28, no 2, 2005, pp. 111-128.

in the NSG and complementary export control system[197]. South Africa and Turkey, for example, were NSG members and did not adequately implement their national export control and nuclear nonproliferation laws. In this sense, companies based in NSG member countries were able to assist the network and receive items from other NSG members essentially without checks on their potential use. States that were outside the NSG, such as Malaysia, were also used to produce direct-use nuclear items without being overseen by authorities[198].

The creation of the NSG in 1974 is an example of shocks in the nonproliferation regime leading to increased efforts to control sensitive nuclear technology. The group was created after India tested its atomic weapon in order to contribute to the nonproliferation of nuclear weapons through the implementation of guidelines for nuclear exports and nuclear-related exports.[199] By that time, nations already signatories of the NPT were trying to limit the export of nuclear equipment, materials and technology. In addition to more restrictive controls, non-NPT and non-Zangger Commitee nations could also participate in the NSG. In order to conduct its first nuclear test, India used plutonium produced in a Canadian-origin reactor and heavy water produced in the U.S.

In 1991, the discovery of Iraq`s procurement efforts also led to the creation of a list of dual –use items to supplement the original trigger list of more sensitive items. Iraq`s clandestine nuclear efforts in the early 1990s were another important shock to nonproliferation regime, which compelled the 40-plus states on the IAEA`s board of governors to acknowledge that its safeguards system needed to be strengthened. The

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[197] David Albright and Corey Hinderstein, "Unravelling the A.Q. Khan and Future Proliferation Networks," The Washington Quarterly 28, no 2, 2005, p. 120.
[198] Ibid.
[199] "The Nuclear Suppliers Group: Its Origins, Role and Activities," INFCIRC/539/Revision6, IAEA website. http://www.iaea.org/sites/default/files/infcirc539r6.pdf

immediate outcome after years of negotiaton was the creation of a new model of safeguards in 1997, the so-called Additional Protocol (AP), which was codified by IAEA information circular 540 (INFCIRC/540). The AP represents greater intrusion into a country`s sovereignty than does IAEA safeguards regime (INFCIRC/153).

According to the new guidelines established by the AP, states should notify the IAEA of plans to build new nuclear facilities, to provide blueprints in advance, to declare nuclear fuel-cycle related research and development activities, and to require reports on all trade in sensitive nuclear technology and materiel. In addition, the AP also grants IAEA inspectors greater access to nuclear facilities on short notice and allows them to take environmental samples to better detect possible violations[200]. As it is explained by the IAEA, " while the chief object of safeguards under INFCIRC/153 is to verify that declared nuclear material was not diverted, the chief objective of the new measures under INFCIRC/540 is to obtain assurance that the State has no undeclared activities[201]."

As of December 31, 2014 124 states have implemented the AP. However, many states entitled to nuclear cooperation have been systematically refusing to implement the protocol, such as: Argentina; Brazil, Egypt, Israel, Malaysia, Pakistan, Saudi Arabia and Venezuela. Iran is an interesting case because the country adhered to the AP in December 18, 2003 but it never really came into force in the Iranian legal system[202]. Most of the time the refusal to implement the AP is more of a political statement than a proof of ill

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[200] George Perkovich, "Abolishing Nuclear Weapons: Why the United States Should Lead," Policy Brief No. 66, Carnegie Endowment for International Peace, October 2008, p.3.

[201] IAEA, "Model Protocol Additional to the Agreement(s) between State(s) and the International Atomic Energy Agency for the Application of Safeguards," IAEA Information Circular, INFCIRC/540 (corrected), September 1997.

[202] Conclusion of Additional Protocols: Status as of 31 December 2014, IAEA website, accessed February 28, 2015. http://www.iaea.org/safeguards/documents/AP_status_list.pdf

intent. Most developing countries will not accept any further commitment under the nonproliferation treaty without much more reliable commitments to nuclear disarmament. The U.S, the European Union, Turkey, Australia, South Korea and other states have also proposed that the providers of nuclear technology and materiel in the 45-member NSG should establish a rule requiring that any state receiving their cooperation must implement the AP[203].

The right of withdrawal of the NPT as acknowledged by article X is an Achilles heel of the nonproliferation regime. It can render the whole safeguards regime and even the AP ineffective when a country is dead set on nuclear proliferation. On January 2003, North Korea announced its withdrawal from the NPT based on article X, alleging that it was being threatened by the U.S. and its allies. Article X guarantees the right of withdrawal from the treaty when a country provides the Security Council with three months`notice of its intention and also a statement of the extraordinary events it regards as having jeopardized its supreme interests. In a statement carried on KCNA, the North Korea`s oficial News agency, the government explained "though we pull out of the NPT, we have no intention of producing nuclear weapons and our nuclear acitivities at this stage will be confined only to peaceful purposes, such as the production of electricity[204]." Three years later, on October 2009, the country conducted its first nuclear test.

In April 2004, right after the unmasking of A.Q. Khan network, the United Nations Security Council issued the Resolution 1540 (UNSCR/1540) in order to prevent the emergence of similar proliferation rings and the acquisition of chemical, biological,

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[203] George Perkovich, "Abolishing Nuclear Weapons: Why the United States Should Lead," Policy Brief No. 66, Carnegie Endowment for International Peace, October 2008, p.3.

[204] Federation of American Scientists, " KCNA Detailed Report Explains NPT Withdrawal," FAS Website, January 22, 2003. https://www.fas.org/nuke/guide/dprk/nuke/dprk012203.html

radiological, and nuclear weapons by terrorist groups. In this sense, UNSCR 1540 closes gaps in the nonproliferation regime and establishes three primary obligations for all United Nations member states: prohibit support to non-state actors seeking WMD and their means of delivery; adopt and enforce effective laws prohibiting activities involving the proliferation of WMD and their means of delivery to non-state actors; and have and enforce effective measures to reduce the vulnerability of many legitimate activities to misuse in ways that would foster the proliferation of WMD and their means of delivery to non-state actors[205]. As it was pointed out by George Perkovich, however, "a nuclear order based on a double standard – a handful of states determined to keep nuclear weapons and also trying to prevent 185 from getting them – is inherently unstable[206]."

As became clear from the implementation of UNSCR/1540 there is a gap between the language on paper and the reality on the ground, especially in relation to export controls. Trade controls are responsibility of states and need strengthening because nuclear export controls are not well developed and not capable of effectively controlling global trade proliferation of sensitive goods, software and technology[207]. Hitherto, nuclear proliferation networks have benefited from both first and second-tier proliferation and export control regimes are examples of supply-side measures that first-tier nuclear supppliers have adopted[208]. The challenge now is to extend these regime in order to capture second-tier exporters as well.

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[205] U.S. Department of State, "UN Security Council Resolution 1540," Diplomacy in Action, accessed February 28, 2015. http://www.state.gov/t/isn/c18943.htm

[206] Ibid.

[207] Matti Tarvainen, "Unfair Trade,"IAEA Bulletin 0, no. 2, May 2009. Http://www.iaea.org/Publications/Magazines/Bulletin/Bull502/50203556163.html

[208] Chaim Braun and Christopher F. Chyba, " Proliferation Rings: New Challengees to the Nuclear Nonproliferation Regime," International Security, Vol 29, No. 2 , Fall 2004, pp. 5-49.

The Proliferation Security Initiative (PSI) is also worth mentioning as an important example of supply-side measure that not only addresses first-tier but also second-tier proliferation states. In 2003, President George W. Bush launched the initiative that brought together eleven nations to agree to practical steps to interdict shipments of missiles, chemical and biological agents, and nuclear components traveling through their national territories. It is important to highlight the fact that Germany and Italy interdicted and seized centrifuges parts aboard the BBC China, a German-owned ship bound for Lybia that originated in Malaysia, via Dubai[209].

As aforementioned, sanctions have also become a popular instrument of coercive diplomacy, especially against proliferant countries. In this sense, the nuclear and missile programs of Iran and North Korea provide a continuing reminder of the importance of preventing illicit trade in proliferation-sensitive technologies[210]. Unfortunately, however, according to August 2013 UN Panel of experts final report on the implementation of sanctions on Iran, the country " (...) continues to seek items for its prohibited activities from abroad by using multiple and increasingly complex procurement methods, including front companies, intermediaries, false documentation and new routes." Apparently, Iran is already following North Korea`s path. After years of sanctions, the volume of North Korea`s arms sales increased by 20% in 2012. The Panel of Experts report issued on June

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[209] White House, "President Announces New Measures to Counter the Threat of WMD," Fort Lesley J. McNair, National Defense University, Washington, D.C., February 11, 2004. http://www.whitehouse.gov/news/releases/2004/02/20040211-4.html

[210] Daniel Salisbury, "How the Private Sector Can Do More to Prevent Illicit Trade," Arms Control Today, Vol. 43, No. 6, July/August 2013, pp. 22-28.

11, 2013 concluded that the imposition of UN sanctions has not halted North Korea`s nuclear program but delayed its timetable[211].

In spite of all the efforts, nuclear proliferant states are always one step ahead. The same variables that undermine the effectiveness of the nonproliferation regime might also render sanctions against Iran and North Korea unsuccessful. After all, the full development of second-tier proliferation countries that are able to produce material and help each others nuclear efforts coupled with lax export controls might incentivize VNPs with nuclear ambitions to cut free from the nonproliferation regime. In addition, sanctions cripple countries` economies, which also make nuclear black markets attractive as an important source of income.

UN Sanctions Against North Korea

Even though the prevention of the proliferation of nuclear weapons in the case of North Korea (DPRK) is a goal universally accepted by the international community, all measures adopted hitherto were unsuccessful[212]. In addition to have constructed a nuclear arsenal, North Korea has also declared that it had diversified its precision nuclear strike means and that the U.S. was within the range of its strategic rocket and atomic weapons[213]. After almost one decade of sanctions, the country continues to affirm that it is simultaneously pursuing economic development and nuclear weapons capability.

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211 Panel of Experts, "Final Report of the Panel of Experts Submitted Pursuant to Resolution 2050," (S/2013/337). http://www.un.org/sc/committees/1718/poereports.shtml

212 Norman A. Bailey, " Economic Sanctions Seldom Work," The International Economy, Summer 2014.

213 "NK Warns U.S. Within Range of Strategic Rockets, Nukes," Korea Times, February 27, 2013.

In order to assess the effectiveness of sanctions it is important to bear in mind that North Korea established its illicit nuclear procurement networks in the 1970s. The country relied on a network of expatriates and agents that traveled around the world to acquire the necessary items to support their nuclear program, which also used goods and services provided by Russia, China and Pakistan. Jack Boureston and James A. Russell highlighted the fact that in addition to using embassies located in industrial places, the North Korean networks also " (...) created fronts such as phony companies, education institutions, and nonprofit organizations to conceal procurement activities, and they established offshore logistics and financial centers to move acquired technology and pay for them[214]."

In July 2006, United Nations Security Council Resolution 1695 (UNSCR 1695) required all member states to prevent trade with North Korea in missile technology[215]. In the aftermath of North Korea`s nuclear test of October 9, 2006 the United Nations Security Council adopted unanimously United Nations Security Council Resolution 1718. It was passed under Chapter VII, article 41 of the UN Charter, and imposes a series of economic and comercial sanctions on North Korea. Since then, international community has been imposing broad sanctions on the country and continued to strengthen the scope of actions. In this regard, UNSCR 1718 was followed by resolution 1874, in 2009, 2087, in January 2013, and 2094, in march 2013. However, the level of cooperation and the scope of implementation varies from state to state.

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[214] Jack Boureston and James A. Russell, " Illicit Nuclear Procurement Networks and Nuclear Proliferation: Challenges Intelligence, Detection, and Interdiction," Stair, 2009, p. 41.
[215] Kim Jina, " UN Sanctions as an Instrument of Coercive Diplomacy against North Korea," The Korean Journal of Defense Analysis, Vol. 26, No3, September 2014, 315-332.

Apparently, North Korea`s trade turnover hit a record high with an increase of 7.8% from the previous year in 2013, and China was the key contributor to this increase with US$ 6.5 billion[216]. The volume of North Korea`s arms sales increased by 20 percent in 2012 and in 2013 the country has engaged in US$ 11 million of arms trade in 2013, comprised of multiple launch rockets and missiles[217]. Kim Jina also explains that "indeed, exports of of ballistic missiles to Egypt, Syria, Iran and Myanmar drew attention from international observers; and anti-tank guided missiles in particular showing up in the Middle East reveal North Korea`s involvement in the arms trafficking market[218]."

UN sanctions are not meant to hamper all economic activities but it is important to notice that China and Russia, two permanent members of the UN Security Council, are the main contributors to North Korea`s foreign trade turnover. Due to the lack of transparency in North Korea`e economy, it is almost impossible to differentiate legitimate from illegitimate businesses. In 2013, North Korea`s trade with China accounted for 89.1 percent of total trade while North Korea`s trade with its second-largest partner Russia surged to US$ 104 million, up 37.3 percent from the previous year[219]. Interestingly, North Korea is using rubles instead of dollars in its bilateral trade with Russia. Therefore, the country is currently allowed to open accounts in Russian banks and bypass certain financial obstacles imposed by the sanctions[220].

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216 "North Korea`s Foreign Trade 7.3 billion Korean Won," Korea Trade-Investment Promotion Agency News Release, May 22, 2014.

217 Debalina Ghoshal, " Defying Sanctions, Iran, North Korea Help Syria Build Missiles," Atlantic Sentinel, February 5, 2014.

218 Kim Jina, " UN Sanctions as an Instrument of Coercive Diplomacy against North Korea," The Korean Journal of Defense Analysis, Vol. 26, No3, September 2014, 315-332.

219 Ibid.

220 Finnbar Bermingham, " Russia Courts North Korea as Putin`s Divorce from West Continues," International Business Times, June 6, 2014.

The Panel of Experts report issue on March 6, 2014 pointed out that it is hard to determine if the level of illicit trade has decreased or increased because not all inspections and seizures are immediately reported to the Sanctions Committee[221]. In addition to being involved in services or assistance related to manufacture, maintenance or use of arms, North Korea is also using multiple and tiered circumvention techniques. The investigation on foreign sourced-items found in the Unha-3 long-range rocket debris shows that off-the-shelf items or items just below parameters were assembled[222]. The Panel also investigated shipments of prohibited items bound for Myanmar, Syria, Eritrea and possible arms-related cooperation with Tanzania, Ethiopia, Uganda and Iran[223].

It is clear that North Korea is also redirecting trade to non-sanctioning nations and also advancing techniques of sanctions evasion via third countries with lax export controls. Kim Jina explains that such techniques include: " false description and mislabeling of cargo; physical concealment measures of the cargo to deceive inspections; falsification of the information concerning the original consignor and ultimate consignee; multiple layers of middlemen obscuring the actual originator of the cargo and its end-user; and multiple trans-shipments[224]."

In addition to North Korea`s technique of sanctions evasion, uneven implementation by UN members states is also a problem that undermines the effectiveness of coercive measures approved by the UNSC. The key to effective

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[221] Panel of Experts, "Final Report of the Panel of Experts submitted pursuant to resolution 2050 (S/2013/337)," http://www.un.org/sc/committees/1718/poereports.shtml

[222] Panel of Experts, "Final Report of the Panel of Experts submitted pursuant to resolution 2050 (S/2013/337)," http://www.un.org/sc/committees/1718/poereports.shtml

[223] Kim Jina, " UN Sanctions as an Instrument of Coercive Diplomacy against North Korea," The Korean Journal of Defense Analysis, Vol. 26, No3, September 2014, 315-332.

[224] Ibid.

sanctions depends on the capacity of member states to enforce measures approved by UN resolutions. Usually, European countries show a higher level of compliance due to a norm-abiding culture and the fact that the European Union adopted Council Regulations concerning restrictive measures against North Korea to ensure uniform application by all EU member states. In contrast, a significant number of member states in Asia take a minimalist approach to sanctions and North Korea utilizes some Southeast Asian ports as routes of transporting prohibited items.[225]. The most traditional illicit trade hubs, for example, are the United Arab Emirates (UAE), China, Hong Kong, Singapore, Malaysia, Taiwan and Turkey, which amounts to 71 percent of the North Korean international trade[226].

In June 2013, the UN North Korea Sanctions Panel released its final report on the implementation of sanctions on North Korea. According to the report, North Korea continues to circumvent UN sanctions in order to supply its WMD programs, import and export conventional arms, and import luxury goods, which is banned by UNSCR 1718 in 2006[227]. The 2013 panel report also highlights developments in North Korea`s nuclear and missile programs over the past year. Those were the main incidents of alleged non-compliance in relation to the prohibitions on imports and exports of sensitive technologies to North Korea[228]:

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225 "U.S. Sanctions Chief Holds Talks with Seoul Officials," Yonhap News, July 30, 2013.

226 Note verbale dated August 3, 2009 from the Permanent Mission of China to the United Nations addressed to the Committee, S/AC.49/2009/23, http://www.un.org/ga/search/view_doc.asp?symbol=s/ac.49/2009/23

227 Panel of Experts, "Final Report of the Panel of Experts Submitted Pursuant to Resolution 2094," (S/2013/337). http://www.un.org/sc/committees/1718/poereports.shtml

228 Daniel Salysbury, " UN North Korea Sanctions Panel Releases 2013 Report," Project Alpha, Centre for Science and Security Studies, King`s College London, June, 2013.

- Interdiction of a shipment of missile-related items believed to be in transfer from North Korea to Syria via China. The goods included "fine grain graffite" cylinders which were falsely declared to be lead pipes[229];

- Attempt to acquire intangibles relating to missile technology by North Korean officials in Ukraine. The information was held in photographs of a secret academic thesis and related to new forms of technological processes for design of missile systems, liquid-propellant engines, spacecraft and missile fuel supply systems and associated computer programs[230].

- Interdiction of the shipment of Transported Erector Launchers (TELs) to North Korea by a Chinese entity[231].

- Ongoing efforts to acquire CNC machine tools by North Korea were documented[232].

UN Sanctions Against Iran

The current Iranian nuclear and missile programs are based significantly on goods obtained from the international marketplace in breach of national export controls or sanctions. Just like North Korea, Iran has also been trying to benefit from the willingness of private firms and lax export controls of certain countries to enable a breach of the arms embargoes put in place by Resolution 1929 in 2010 [233]. In spite of the potent barrage of unilateral and multilateral sanctions, Iran continues to drive illicit procurement networks,

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[229] Ibid.
[230] Ibid.
[231] Ibid.
[232] Ibid.
[233] Daniel Salisbury, "How the Private Sector Can Do More to Prevent Illicit Trade," Arms Control Today, Vol. 43, No. 6, July/August 2013, p. 23.

creating state-sponsored procurement networks that seek to hide the true purpose of goods and identify the most effective ways to bypass or find loopholes in export regulations[234].

Iran has a long history of engagement in illicit nuclear trade. In 1987, it became the Khan network`s second client after Pakistan when it purchased a set of centrifuge blueprints, a nuclear weapon design blueprint and sample pieces of obsolete equipment from the Pakistani program[235]. Iran`s procurement network is sophisticated, involving the top tiers of government, universities, the Iranian Revolutionary Guards Corps (IRGC) and also institutions outside of formal state control, such as the bonyads – special cooperative corporations that are responsible for a large segment of the Iranian economy and manage groups of companies with offices within Iran and around the world.

In the national Iranian procurement system, the IRGC uses Iran`s Defense Industrial Organization (DIO) and its subsidiaries, some universities, and the bonyads in order to acquire dual-use nuclear technology in countries such as Japan and Germany. In the Iranian procurement attempts abroad, it is common to use of diplomatic personnel to make contacts, front companies, falsified end-user certificates to conceal end users and middlemen to contact suppliers[236]. The nuclear-related material acquired by Iran in the past few decades also include high-strength aluminum and steel, electron beam and welders, balancing machines, vacuum pumps, computer-numerically controlled (CNC) machine tools and flow-forming machines to whole centrifuges and uranium conversion

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[234] David Albright, Andrea Stricker, and Houston Wood, "Future World of Illicit Nuclear Trade: Mitigating the Threat," Institute for Science and International Security, July 29, 2013.
[235] Jack Boureston and James A. Russell, " Illicit Nuclear Procurement Networks and Nuclear Proliferation: Challenges Intelligence, Detection, and Interdiction," Stair, 2009, p. 34.
[236] Ibid, p. 34.

plants[237]. Apparently, Iran may even have invested in foreign companies to facilitate its procurement needs, such as the Rio Tinto-Zinc mining company in Namibia[238].

Iran has been targeted by U.S. sanctions since 1979 but the 2002 revelations regarding undeclared nuclear activities fundamentally changed the international political and diplomatic debate around the necessity to use coercive diplomacy in order to change policy-direction. Thus, in 2005 the increasing international concern regarding Iran`s work on uranium enrichment, combined with the IAEA finding that Iran was in breach of its nuclear safeguards obligations under the nonproliferation regime, prompted the UN to impose a first round of sanctions through Security Council Resolution 1737.[239] Afterwards, more restrictive measures have been approved by the UNSC to impede the progress of Iran`s nuclear and ballistic missile programs. In this regard, UNSCR 1737 was followed by the imposition of resolutions 1747, in 2007, 1803, in 2008, and 1929, in 2010.

In addition to increasingly vigorous and wide-ranging sanctions, the U.S. has also used its leverage over the international financial system to create the most comprehensive unilateral sanctions regime in history, which also convinced the European Union to implement its own set of unilateral sanctions[240]. According to Ali Vaez and Sadjadpour, 2012 " was the most tumultuous period for the Iranian economy since 1994, when an external debt crisis triggered a major recession. In one calendar year, GDP per capita

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[237] David Albright and Corey Hinderstein, " The Centrifuge Connection," Bulletin of the Atomic Scientists, 2004, pp.61-66.

[238] Martin Bailey, and Shyam Bhatia, " Namibia Uranium May Fuel Iran`s A-Bomb," The observer, May17, 1987.

[239] Matthew Moran, and Daniel Salisbury, "Sanctions and the Insurance Industry: Challenges, Risks and Opportunities," Business and Politics, Vol.16, No.2, 2014, p.433.

[240] Bijan Khajehpour, Reza Marashi, and Trita Parsi, " Never Give In and Never Give Up: The Impact of Sanctions on Tehran`s Nuclear Calculations," National Iranian American Council, March 2013.

declined by nearly 8 percent; inflation increased by over 10 percent and unemployment inched close to 20 percent[241].” Furthermore, Hassan Rouhani`s election as president might have indicated a change in Iran`s domestic politics. At least the country was able to resume the nuclear talks with the P5+1.

Despite the clear economic slowdown, Trita Parsi affirms that no data suggests that Iran`s nuclear program has been affected since the last round of sanctions was approved in 2010. On the contrary, the program appears at best entirely unaffected by the sanctions because escalating them as a bargaining chip also gives Iran the incentive to advance its program for the same reason[242]. According to Parsi`s interview with elements in the current Iranian government, the continuation and acceleration of the nuclear program in response to sanctions served three purposes: “ convincing the UNSC that sanctions are futile; raising the cost for the West`s alleged refusal to deescalate the conflict; and compelling the West to accept Iran`s right to enrich uranium[243].”

On 11 June 2014, the UN`s Panel of experts established pursuant to UNSCR 1929 (2010), released its 2013-2014 report showing that Iran has been breaching sanctions by procuring both controled and non-controled items. Interestingly, the report highlights the fact that sanctions have played an important role in constraining Iran`s nuclear effort. However, it states that the recent decrease in detected cases could be a result of better concealment[244]. The 2013-2014 report contains details of several illicit procurement

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241 Ali Vaez, and Karim Sadjadpour, “ Iran`s Nuclear Odyssey: Costs and Risks,” Carnegie Endowment for International Peace Report. Available from: http://carnegieendowment.org/2013/04/02iran-s-nuclear-odyssey-costs-and-risks/fvui.

242 Bijan Khajehpour, Reza Marashi, and Trita Parsi, “ Never Give In and Never Give Up: The Impact of Sanctions on Tehran`s Nuclear Calculations,” National Iranian American Council, March 2013.

243 Ibid.

244 Project Alpha, “2013-2014 Report from the UN`s Iran Sanctions Panel of Exports,” Center for Science and Security Studies, King`s College, London, 18 June, 2014.

attempts, which were subject to interdiction. It is important to stress, however, that there is not enough information to connect the case with a nuclear or missile effort specifically. The report also concluded that China must improve the implementation of nonproliferation measures, because it is a frequently source of technology interdicted en route to Iran.

Those were the main illicit procurement attempts conducted by Iran in the breach of the last round of sanctions imposed by the UNSC[245]:

- Interdiction of 720 kg (1800 bobbins) of Carbon fibre manufactured in Japan and shipped via China. Iran has been working to introduce centrifuges that are constructed from carbono fibre for a long time, because its indigenous production is not capable of producing high-quality grades.

- Interdiction of 7600 kg shipment of aluminum 70705T0 in rod form en route to Iran from China. The material was supposed to be used in Iran`s IR1 centrifuge.

- Interdiction of 670 inverters that were stopped en route to Iran from China. According to experts they could be used to operate in the frequency range required by Iranian centrifuges.

- Interdiction of 7000 stainless steel bellows on route to Iran from China.

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https://www.acsss.info/proliferation/item/322-2013-2014-report-from-the-un-s-iran-sanctions-panel-of-experts

[245] Ibid.

- Interdiction of a cold pilger machine en route to Iran from China. This kind of machine is usually used to produce pressure tubes for a heavy water reactor, such as that under construction at Arak.

- Interdiction of aluminum grade 2024T3 and cylinder internal diameter 270 mm en route to Iran from China. There is no further information about it but this material is usually considered to be a missile-related good.

- Interdiction by Israeli authorities of a shipment of rockets, mortars and ammunition that were being exported by Iran.

Conclusion

The analysis of both UN reports on the implementation of sanctions on Iran and North Korea corroborate the theory that latent proliferation and proliferation networks represent two major and broad challenges to the survival of the NPT[246]. In addition, it also provides evidence that the sanctions regime alone is failing to prevent the engagement of nuclear proliferant states in illicit nuclear trade. Furthermore, proliferation networks exacerbate the latent proliferation challenge and illustrate the inadequacy of current export controls, especially in developing world countries. Thus, the full development of proliferation networks will ultimately render export control regimes

[246] Chaim Braun and Christopher F. Chyba, " Proliferation Rings: New Challenges to the Nuclear Nonproliferation Regime," International Security, Vol 29, No. 2 (Fall 2004, pp. 5-49.

limited to the traditional nuclear suppliers group and undermine the effectiveness of the nonproliferation treaty[247].

It is important to highlight the fact that Iran and North Korea utilizes similar methods in order to acquire illicit goods for their respective nuclear programs. The cooperation with A.Q. Khan network in the past helped them to speed up their programs and establish a list of needed goods. Moreover, both governments rely on domestic procurement organizations, which are responsible for their procurement domestically and abroad. Both UN reports also show that expandable middlemen located abroad are hired to take care of placing orders, shipping and logistics. It is also clear that North Korea and Iran use dipomatic personnel for research and purchase of dual-use components. Of the UN Security Council states, China and Russia remain important financing nodes for North Korean and Iranian proliferation activities because of their failure to fully implement UN resolutions.

Many developing countries have a poor history of implementing trade controls and UN sanctions because of a culture of indifference to stopping the spread of sensitive nuclear technology[248]. Lax export controls are a reality in many countries in Asia, where private companies – usually considered to be the first line of defense against illicit nuclear trade – often do not question the buyer or the purpose of the declared end use. In addition to the lack of regulation, nuclear proliferation networks also target developing states because of their increasing ability to manufacture reliable nuclear and nuclear related dual-use components. It is interesting to notice, for example, that Taiwan and

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[247] Ibid, p.48.

[248] David Albright, Andrea Stricker, and Houston Wood, "Future World of Illicit Nuclear Trade: Mitigating the Threat," Institute for Science and International Security, July 29, 2013.

South Korea have been failing to prevent smugglers from acquiring controlled goods for Iran or North Korea[249].

Despite the fact that proliferant states such as India, Pakistan and Iran and former proliferant states such as Argentina may resist reforms in trade control systems and rigorous enforcement of trade control laws, it is China, a NWS under the NPT that also participates in the Zangger Comittee and the NSG, that poses special challenges to stopping illicit trade in nuclear and nuclear-related commodities. It is possible to infer from the reports, for example, that the country is usually involved in the shipment of illicit goods en route to Iran and North Korea. The situation will probably get worse in five to ten years because Chinese companies will be able to manufacture goods for use in sensitive nuclear facilities, including gas centrifuge plants.

Despite the fact that China does not make enough higher quality goods in sufficient quantities, most of the illicit trade in China involves private Chinese companies. Proliferant states usually resort to them when they need higher quality goods for their nuclear facilities. Therefore, it is widely believed that increasing privatization in China will increase illicit trade due to the lack of adequate scrutiny of their exports. Iran, which is more constrained than North Korea in China, can still obtain dual-use goods and raw materials from Chinese suppliers working through private Chinese companies that approach U.S. and European high technology subsidiaries with locations in China.

Iran and North Korea have been purchasing a wide variety of goods for their gas centrifuge programs in China, but many of these high-tech goods are made in Europe, the U.S. and Japan. Actually, they are transshipped through China to either Iran or North

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[249] Andrea stricker, "United States Busts Likely North Korean Transshipment Scheme," ISIS, May, 24, 2013. http://isis-online.org/isis-reports/detail/case-study-united-states-busts-likely-north-korean-transshipment-scheme/

Korea. It is interesting to notice that many Chinese goods are not of the same high quality as those manufactured by developed countries. That is the reason why that Iran and North Korea prefer to import key vacuum pumps used in gas centrifuge programs, high quality carbon fiber, and pressure transducers from Western countries[250].

It is also clear that Iran and North Korea are trying to benefit from lax export controls in other developing countries. If export controls are not effective in China, it is likely that the situation is even worse in developing countries that are not part in any effort to restrict the exports of dual-use items. Years ago the Malaysian firm Scomi Precision Engineering and the Turkish EKA electrical equipment company, for example, had a central role in producing centrifuge technology for the Libyan nuclear program. Turkey has adopted dual-use export controls but Malaysia remains outside both the Zangger Committee and the NSG. It would also be important to implement effective export controls in countries that are nuclear non-NPT states, such as India, Israel and Pakistan[251].

It is also likely that North Korea will continue to help Iran overcome some technical challenges, especially if it continues to develop its uranium enrichment program and builds devices using weapons-grade uranium. Apparently, Iranian scientists are invited as observers at every major North Korean nuclear or missile test. Furthermore, North Korea is utilizing centrifuges based on the Pakistani P-2 design, which is the basis for Iran`s recently installed IR-2m centrifuges.

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[250] David Albright, Andrea Stricker, and Houston Wood, "Future World of Illicit Nuclear Trade: Mitigating the Threat," Institute for Science and International Security, July 29, 2013.

[251] Anupam Srivastava, and Seema Gahlaut, "Curbing Proliferation from Emerging Suppliers: Export Controls in India and Pakistan," Arms Control Today, Vol.33, No 9, September 2003.

The uneven implementation of sanctions by developing countries - and permanent UN Security Council members such as Russia and China - is clearly undermining the effectiveness of coercive diplomacy. The spread of nuclear weapons technology is a trend that will probably continue in the near future. Thus, it is likely that more developing countries with lax export controls will have access to sensitive nuclear technology. Moreover, the failure of sanctions might legitimate the use of military force by Israel against Iran, a country that might take over the central role of "rogue supplier, " due to its growing nuclear capabilities and increasing hostility to international trade control regimes[252].

Illicit nuclear trade might be outside the scope of the NPT but the absence of effective export controls undermines the nonproliferation regime and creates the perfect environment for nuclear proliferation networks and VNPs. As nuclear cooperation increases, it is likely that more countries will try to illegally acquire goods for their nuclear programs in the black market. After all, nuclear trade is a highly regulated business and "rogue suppliers" will always exist to supply the demand for sensitive nuclear technology. In this sense, it is not reasonable to believe that illicit networks can be defeated completely, but they can certainly be controled. By the way, it is important to highlight the fact that all states party to the nonproliferation treaty are obliged, pursuant to article III, to implement export controls. As mentioned previously, this obligation was reinforced by UNSCR 1540, which requires all states to implement export controls to prevent the spread of WMD.

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[252] David Albright, Andrea Stricker, and Houston Wood, "Future World of Illicit Nuclear Trade: Mitigating the Threat," Institute for Science and International Security, July 29, 2013.

Finally, the participation in the development and implementation of export controls should be broadened and multilaterally agreed export controls should be developed in a transparent manner, engaging all states. In this regard, second-tier states could learn from the expertise of first-tier states. After all, export controls coupled with the universal implementation of IAEA safeguards and the Additional Protocol are the most effective defense against the perils of illicit nuclear trade and would reinforce the effectiveness of the NPT.

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Master of arts in Global Security Studies

2007-2008 **Rio Branco Institute – Diplomatic Academy of the Brazilian Ministry of Foreign Relations**

Brasilia, Brazil
Graduate certificate in Diplomacy

2000 – 2003 **Catholic Pontifical University of Rio de Janeiro**
Rio de Janeiro, Brazil
Bachelor's in Social Communication — Journalism

EXPERIENCE

Jan. 2012 **Embassy of Brazil**

Washington, DC
Cultural Attaché, Head of the Embassy's Cultural Sector

- Implemented Brazilian cultural policies in the U.S.
- Spread Brazilian culture through music, cinema, literature, dance, and photography
- Facilitated contact between U.S. cultural organizations and their Brazilian counterparts
- Facilitated contact between U.S. artists and producers and their Brazilian counterparts

Jun. 2012 Rio +20 – United Nations Conference on Sustainable Development
Rio de Janeiro, Brazil
Diplomatic Liaison

- Advised the Prime Minister of Turkey throughout the United

Nations Conference on Sustainable Development

Dec. 2008 - Brazilian Ministry of Foreign Relations

Dec. 2011

Brasilia, Brazil
Advisor to the Head of State Protocol

- Organized logistics for visits of Brazilian Government officials, Foreign Ministers, and Heads of State to: the U.S., Portugal, Spain, Cuba, Iran, Mozambique, Haiti, Germany, China, Russia, India, South Africa, Turkey, Paraguay, Argentina, Uruguay, Ukraine, Libya, Syria, East Timor, Palestine, France, Canada, Singapore, Peru, Honduras, El Salvador, Colombia, and the U.K.
- Key organizer of the BRIC-IBAS Summit of 2010
- Arranged international travel for the President of Brazil to: Venezuela, Vietnam, Trinidad and Tobago, the U.S. (New York, Pittsburg, and the U.N. General Assembly), Iran (Trilateral Negotiations among Brazil, Turkey, and Iran), Palestine, Tanzania, Mozambique, Libya, Saudi Arabia, Turkey, Israel, Argentina (Buenos Aires, Mar del Plata, and Bariloche), Bolivia, Ecuador, Guatemala, Ukraine, Denmark (Decision for the Host City of the 2016 Olympics), China, and Haiti
- Coordinated the Brazilian President's Advance Party for international visits
- Negotiated the Brazilian President's agenda for official visits abroad

Jan. 2003 - Instituto Millennium (www.imil.org.br)

Jul. 2005 Rio de Janeiro, Brazil
Cofounder and Youth Group Coordinator

- Organized academic debates
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- Published articles on the economy, international relations and policy on the Instituto Millennium website

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Portuguese (native), English (fluent), Spanish (fluent), French (beginner), German (beginner)